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THE IMPACT OF THE INTRODUCTION OF VISUAL DISPLAY TERMINALS ON THE JOB CHARACTERISTICS, JOB SATISFACTION AND WELL-BEING OF USERS IN GOVERNMENT OFFICES

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THESIS SUMMARY

The impact of the introduction of visual display terminals on the job characteristics,job satisfaction and well-being of users in government offices.

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The proliferation of visual display terminals (VDTs) in offices is an international phenomenon.Numerous studies have investigated the health implications which can be categorised into visual problems, symptoms of musculo-skeletal discomfort, or psychosocial effects. The psychosocial effects are broader and there is mixed evidence in this area.

The inconsistent results from the studies of VDT work so far undertaken may reflect several methodological shortcomings. In an attempt to overcome these deficiencies and to broaden the model of inter-relationships a model was developed to investigate their interactions and the outputs of job satisfaction, stress and ill health. The study was a two-stage,long-term investigation with measures taken before the VDTs were introduced and the same measures taken 12 months after the "go-live" date.

The research was conducted in four offices of the Department of Social Security. The data were analysed for each individual site and in addition the total data were used in a path analysis model. Significant positive relationships were found at the pre-implementation stage between the musculo-skeletal discomfort, psychosomatic ailments, visual complaints and stress. Job satisfaction was negatively related to visual complaints and musculo-skeletal discomfort. Direct paths were found for age and job level with variety found in the job and age with job satisfaction and a negative relationship with the office environment. The only job characteristic which had a direct path to stress was "dealing with others".

Similar inter-relationships were found in the post-implementation data. However, in addition attributes of the computer system, such as screen brightness and glare, were related positively with stress and negatively with job satisfaction. The comparison of the data at the two stages found that there had been no significant changes in the users' perceptions of their job characteristics and job satisfaction but there was a small and significant reduction in the stress measure.

Keywords: Visual display terminals, job design, satisfaction, stress.

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1. INTRODUCTION

Chapter Summary

The background to the growth of the use of VDTs in offices generally, and government offices specifically, is discussed. The general concerns, fears and hopes regarding the use of VDTs is explored followed by discussion of models of interaction relating to the use of VDTs in offices.

1.1 BACKGROUND

1.1.1 The mechanisation of the office has been growing apace since the first world war. Typewriters were the first office machines designed to speed up the productivity of the office worker. Adding machines, photocopiers, telex transmitters were developed and introduced into the office to aid the clerical worker perform their tasks more rapidly and with improved quality of output.

1.1.2 Gradually machines developed from simple single function equipment to those with more complex multi-function facilities. In particular, the simpler machines did not necessitate any radical changes in job content and skill requirements but as the machines became more complex, job content and skill requirements changed. With the change in

coincidental growth of the scientific management movement, influenced strongly by F W Taylor, there were far reaching effects on work design, job content and organisational structure.

1.1.3 The first phase of the application of electronic data processing further developed, more dramatically than the preceding machines, the intensification of job specification, functional work flow - line systems, and the rationalisation of office procedures (F.D.Dy 1985).

1.1.4 The proliferation of VDTs in offices is an international phenomena. In the Federal Republic of Germany about 300,000 persons were working in 1982 on VDTs (Staehle 1984) and it was being forecast in 1980 that 40% of the office work in Germany would be carried out by office computers by 1990 (Damodaran 1980). Dreyer et al (1981) commented that in West Germany "in some computerised offices there is one terminal for every three employees". So the progress is well advanced in many employment sectors there. In America, the investment in office electronic technology is enormous; 750 million dollars spent on stand alone word-processing equipment in 1978 (Bikson, Gutek, and Mankin 1981). An eight year forecast in 1981 by International Resource Development Inc., predicted that local computer networks would represent a 3.2 billion dollar market by 1990 (Bikson 1981). Other forecasts support this view of a massive growth in office information technology in the United States, with an expectation of 40 to 50 percent of workers using VDTs daily; some 38 million workstations being installed in offices, factories and schools (Guilano 1982). Following a

survey of 1,400 American manufacturing companies the forecast for the growth of wordprocessing and data-processing terminals in the USA was that sales would reach 4,200 million dollars by 1987 and the same report expected 100% of secretaries would have a VDT by the end of 1985 (Kehoe 1984). In the UK the trend is equally marked. Surveys conducted in 1983 found that of 255 companies 79 percent were using word-processors and 78 percent micro-computers, whilst 60 percent of local authorities were using word-processors (Dy 1985). In 1985 the Butler Cox Foundation predicted that over 60 per cent of clerical workers would be using a terminal (Wheatley 1985).

1.1.5 These developments are particularly true of UK central government departments.In these departments in 1984 over 700 mainframe computers were being used, with 900 small computers and 10,000 visual display terminals (VDT). The largest user is the DHSS with 70 large computers and 3000 microcomputers (National Audit Office 1984). There are other major schemes being implemented already or at the planning and development stages. About 18,000 VDTs have been introduced into the Inland Revenue Tax Districts in order to computerised Pay as You Earn Taxation and 10,000 in the Unemployment Benefit Offices. By the mid-1990s DHSS will have introduced approximately 30,000 VDTs into the local Social Security Offices (DHSS-HMSO 1982).

1.1.6 The "Operational Strategy Plan" for DHSS envisages the computerisation of the full range of Social Security services. Local offices will have VDTs linked to local controllers and then to four Area Computer Centres, which

house the main frame computers in different locations, and all networked into the central computers at North Fylde and Newcastle-on-Tyne Central Offices. The development of the final system was originally planned over a twenty year period with an original estimate of £720,000 million, saving being forecast at £1880 million (DHSS - HMSO 1982). In addition to these new major schemes, many main frame computers, when replaced with second generation machines, are having on-line access systems. These systems are moving away from large data-processing input procedures, through punch cards and centralised computer operations, to more dispersed VDT locations and integrating them with manual clerical operations. It has, in many instances, also been a move from using computers for mainly internal management functions (accounting, management information, modelling, and forecasting systems) to assisting directly the staff dealing with the claimant and consumers of department's services.

1.1.7 Employers are seeking to improve efficiency and effectiveness in the way their work is done and see the computer as contributing in a major way towards those objectives. The facilities, which over recent years are being offered by the manufacturers, have widened to include not just word processing and data processing but electronic mail, micrographics, teletex and view-data etc. This is consequently widening the spectrum of people in the office that are directly affected by the new technologies. Work organisation and the job content of more and more office workers and office managers are being affected.

1.1.8 As well as the costs of the equipment and installation there are considerable business benefits to be

gained from installing information technology in the office: cost reduction in use of text and its transmission and storage, error reduction,increased flexibility, increased speed of activity and improvement in management planning and control. There are also both benefits and costs for the human implications of new technology.

1.2 IMPACT ON THE NATURE AND CONTENT OF WORK

1.2.1 The effects of computer systems and VDTs have received widespread comment ranging from the effects on the individual to the macro-economic effects of technological innovation in displacing jobs. Many of the findings and conclusions are contradictory and essentially fall into two opposing views the pessimistic and the optimistic.

The optimistic

1.2.2 This view emphasises the benefits that can be gained from the use of the new technologies. There are a number of reports on new types of work arrangements which have been brought about by office automation (eg Rank Xerox, 1983; Kraut 1987), as well as the introduction of computer systems being seen as an opportunity for re-designing jobs and wider beneficial organisational design (Hawgood, Land and Mumford 1978, Gough and Stiller 1983, McFetrich 1982). There is however a sparsity of empirical evidence to support this view; much of the comment being anecdotal and without sound methodological foundation.

1.2.3 Office automation systems are seen as offering improvements in communication through the facilities of

electronic mail systems. Such uses of new technology have the potential to provide more carefully thought out communication instead of the pressure of the instant response frequently required by telephone and face to face communication. The capability is available for the immediate storage of messages sent and received with the consequent benefit of fewer misunderstandings. There is support for the benefits of office automation in the area of communications (eg Conrath et al, 1981).

1.2.4 There is the possibility of changing the tasks of managers, as the jobs of their sub-ordinates are changed, and also it will provide improved tools and information with which managers can enhance their own performance. The word-processing, data-base and spread-sheet software packages, now available to professional and technical workers can greatly improve the contribution of these skilled workers, to their organisations (Wainwright and Francis 1984).

1.2.5 Productivity is being increased at various levels in the organisation; typist, secretarial, clerical and managerial, through the application of new technologies (Wheatley 1985). Many of the routine repetitive tasks can be performed or significantly facilitated by the computer systems (Hirschheim 1985), with job satisfaction and customer service being improved (Plummer 1979). The Manpower Services Commission study on text processing describes the improved job satisfaction due to the office automation systems (MSC 1982). In a survey of four organisations Wainwright and Francis (1984) found the majority of jobs they examined were rated as having improved.

The Pessimistic

1.2.6 This general viewpoint considers that greater VDT use creates more boring, routine and de-humanised jobs. Jobs can be simplified through the variety of tasks being reduced. Manoochehri (1985) instances an insurance company's claims processor who had several aspects of the work to do prior to automation, such as checking on the information required, doing the arithmetical calculations, checking the final correspondence, whereas now the clerk was only to punch some information into the terminal for each claim. Some jobs have their content fragmented as well as simplified by removing and automating elements of it, operators becoming both apathetic and deskilled (Boddy and Buchanan 1982). The standardised sub-routines which have been computerised for architects and journalists have in some instances reduced the creative and design options open to them (Segal-Horn 1985).

1.2.7 Due to many computer software systems handling algorithm and decision making rules, formally exercised through the worker's judgement and decision making, the skill requirement of the job is reduced. The object and purpose of the job and its relationships to other parts of the organisation become more remote and the pride and accomplishment in their work can be reduced (Downing 1980, Manoochehri 1985). The acquisition of new skills, such as clerks learning to use word-processing packages, often are seen only as a short-term benefit by the worker. Once the learning process has taken place and the novelty of the new procedures wear off the activities become boring and routine (Dy 1985, Boddy and Buchanan 1982, Huws 1982,

Downing 1980).

1.2.8 The productivity gains espoused by the "optimist" is regarded by the "pessimist" as too simplistic. At the managerial level the unstructured nature of the job and the high degree of activities which are not conducive to automation are serious difficulties (Oborne 1985, Hirschheim 1985). Any attempts at pressing managers to use automated systems would be met with at best passivity and at worst resistance (Hirschheim 1985). Clerical, secretarial and typists jobs may well have dysfunctional consequences (deskilling, less control, lost jobs) when automated, such that the long term productivity is likely to decline due to high absenteeism, higher turnover and poorer standards of work (Hirschheim 1985, Dy 1985, Oborne 1985).

1.2.9 Higher degrees of control and supervision can be exercised by management, through monitoring of work tasks and the system setting the pace of the work, thereby increasing the pressure to produce higher outputs. Particularly for data-entry workers there is often little or no discretion in checking or scheduling their own work. Discretion even at management level can be reduced by centralised computer-based decision making. Information flows from the lower levels of management flow up the organisation with the message of central control being increased (Boddy and Buchanan 1982, Wainwright and Francis 1984, Huws 1982,Segal-Horn 1985, Manoochehri 1985, Dy 1985, Hirschheim 1985).

1.2.10 Social relationships, worker inter-personal behaviour and communication patterns have been influenced by office automation systems. VDT operators have much less

need to interact to perform their tasks because of the greater structuring and functionalisation of the work (Manoocheheri 1985). Within word-processing pools there is little need for interaction either within their pool or outside with authors, particularly if there are electronic mail links (Dy 1985, Picot et al 1982). Picot et al (1981) found that despite the promise of new technologies to improve communications within organisations, only the less complex written form is open to such transmission. The complex and richer range of inter-personal communications which make up the core of intra-organisational management activity, such as co-ordinating complicated tasks, solving complex problems, developing innovation strategies, and motivating people, will only be influenced to a minor degree by the text oriented communication technologies. They concluded that an over enthusiastic deployment of the new technologies was being feared and there was the potential for resistance from the study they conducted.

1.2.11 The proliferation of information within organisations, due to new technology, was found to overload managers with information which produced a higher degree of error in their decision making (O'Reilly 1980). Trauth, Kwan and Barber (1984) concluded that computer-based messaging systems do not always improve the organisation's communications.

1.2.12 Many users of VDTs complain about eye problems, headaches and backaches, particularly those who are using the terminal for long periods without breaks, (Cakir et al 1980, Fellman et al 1982; Grandjean 1980, 1984). A number of authors claim that stressful aspects of jobs are

exacerbated when VDTs are introduced (Dy 1985). The increase in author's demands for work to be retyped (Buchanan and Boddy 1982); the frequent breakdown of the maohine (Johansson and Aronsson 1984); slow system response times (Marquis and Douglas, 1985), lack of control over the speed of work (Smith et al 1981) are features which create a greater feeling of work overload.

1.2.13 A small number of studies suggest that jobs with little variety before computerisation are further impoverished by the introduction of VDTs. However jobs with greater variety, discretion, and more interesting content do not appear to be similarly effected (Sauter et al 1983).

Man-machine models

1.2.14 The thrust of a large proportion of the research into the impact of computer systems, and in particular the use of VDTs by office workers, has been to reduce discomfort, reduce errors, and to maximise efficiency and the comfort of the user. The capabilities of the operator and the parameters of the computer system and VDT have been examined to produce a better fit. The establishment of a closed-loop system has been set up which links the user through the keyboard and screen interaction (see Figure 1.1)

1.2.15 The machine displays information to the user who interacts through an input device which affects the machine. The environmental interactions will produce more open-loop systems.The comfort levels of the user which could well alter the user's perceptions of the VDT and computer system; glare from bright windows, light on the screen, noise from the printers or other office noise disruption. Such

disruptions, and the pressures exerted by other procedures required by the job, can reduce concentration. In a study of 254 computer users, some clerks and some managers, the consequences of poor computer interface design were different for each group. The clerks could not escape using the machine, so frustration built-up to high levels whereas the managers, who were occasional users, either didn't use the system at all or used it very little (Eason, Damodaran, Stewart 1974). The man-machine environment is therefore wider than the immediate workplace; job level, job design, office environment, and organisational culture impact upon the man-machine system. Numerous different sources of such impacts develop the model into a more open-loop system.

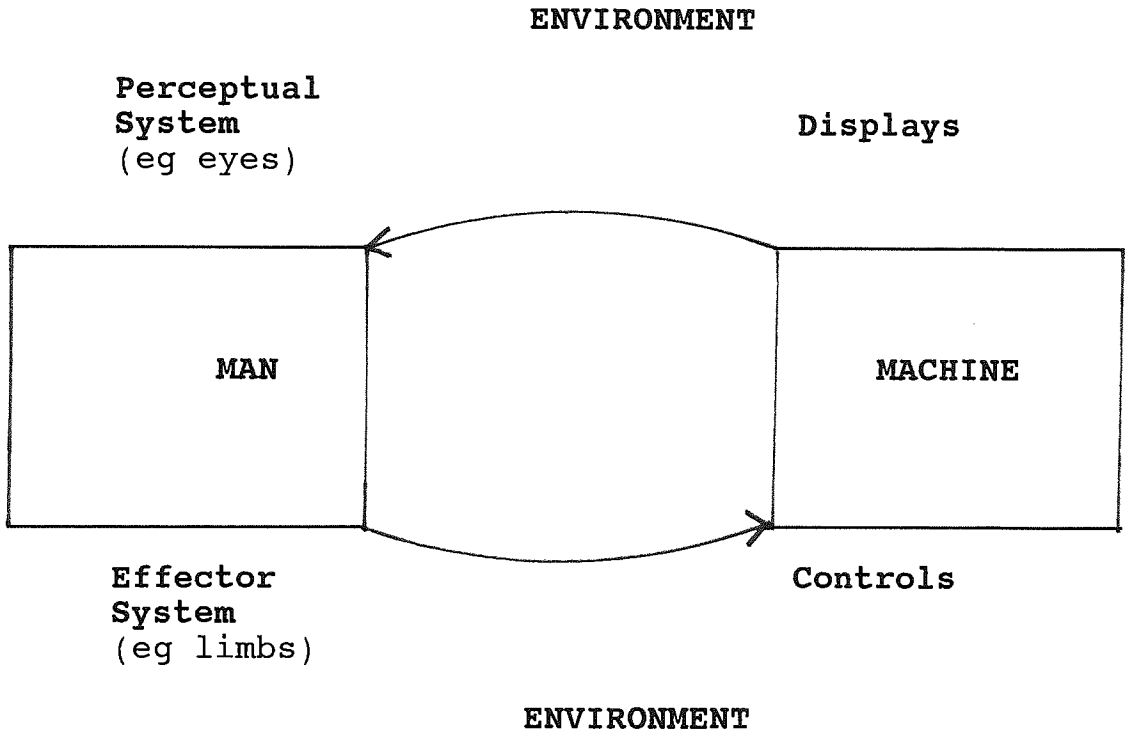


Figure 1.1 The closed-loop man-machine model (Oborne 1985)

1.2.16 In order to understand more fully the contribution of these wider influences, conceptual models have been developed

by a number of researchers. These models are designed to attempt to clarify and supplement what is currently known about specific attributes of the model as they relate to people's behaviour and responses to the office and computer system environment (Morans and Spreckalemeyer 1986). These models have been derived from different methodological and research interests.

1.2.17 Using the Person-Environment Fit methodology, Chadrow (1983) developed that model (see Figure 1.2) to examine the outcomes of job satisfaction, health risk and psycho-somatic illness. The influence of the user's job attributes and the hours spent interacting with the VDT and people, were some of the main independent variables.

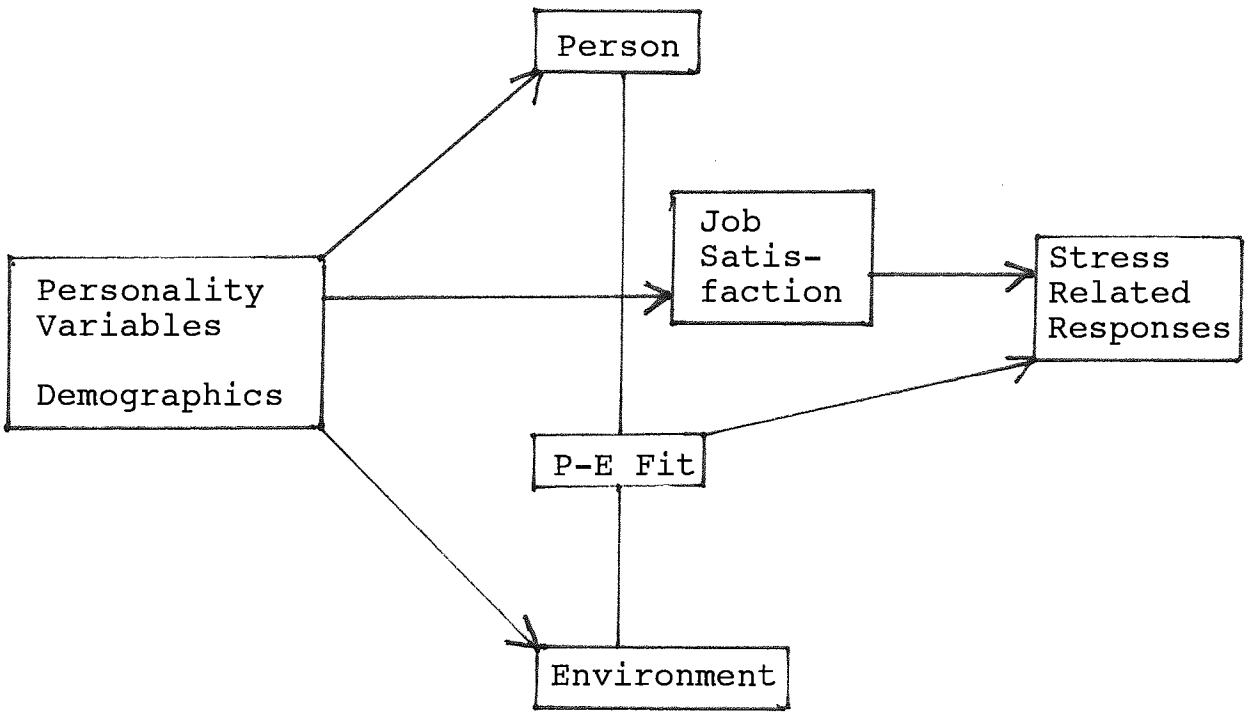


Figure 1.2 An interactional model of Person-environment fit job satisfaction, stress and VDT work (Chadrow 1983)

1.2.18 Turner and Karasek (1984) devised a model to

hypothesise the effects which occur in the changes of task structures when computers are received in the work place (see Figure 1.3). They examined the relationship between task dimensions, the operator's performance and well-being, and the computer system design parameters that have influenced the task structures. They examined the three-part causal links - application of system parameters to task characteristics to user effectiveness and health - and suggest ways in which the improvement of dialogue quality, the use of small systems matched more closely to user needs, could improve effectiveness and user well-being.

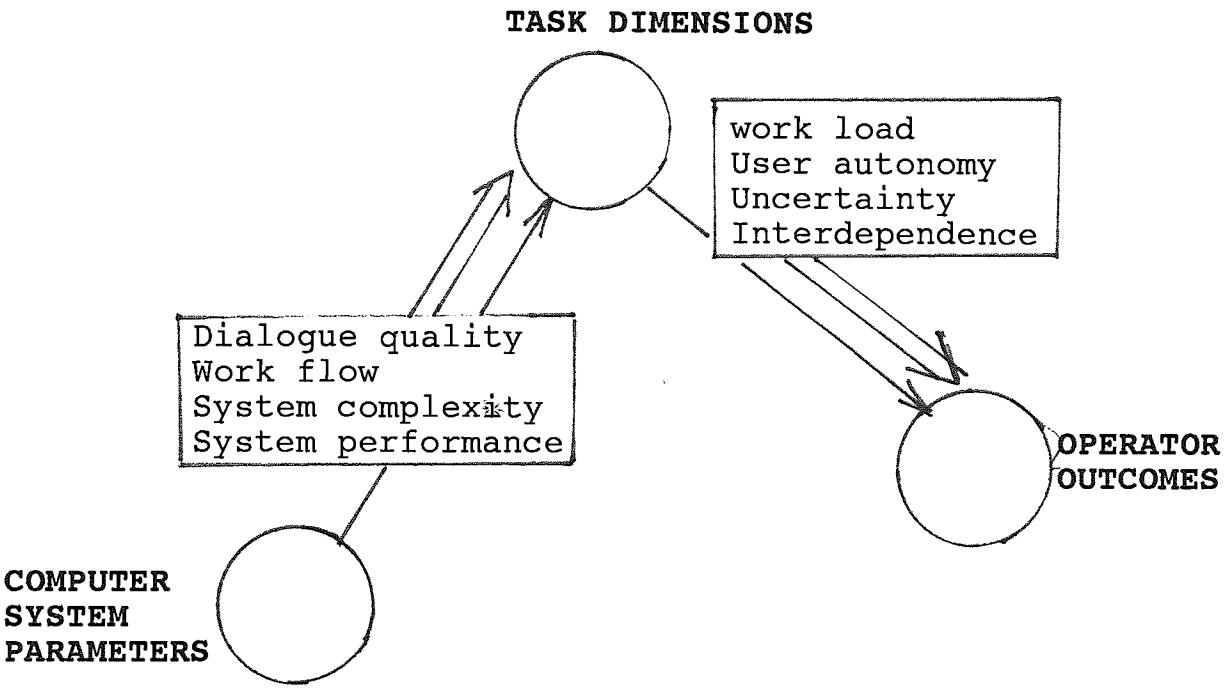


Figure 1.3 Pathways from computer system parameters to operator outcomes (Turner and Karasek 1984).

1.2.19 Evaluation of the work environment was the focus of the conceptual model building suggested by Marans and Spreckelmeyer (1986) (See Figure 1.4). They suggest that satisfaction with the work environment is dependent upon the individual's perception and assessment of that environment. The person's evaluation is dependent upon two-factors - how

the person perceives it and the standards against which they judge it. They recognise that perception is distinct from the objective environmental attributes and differences in perception between individuals are recognised. They also suggest that satisfaction with the environment and general job satisfaction interact to influence the eventual outcomes.

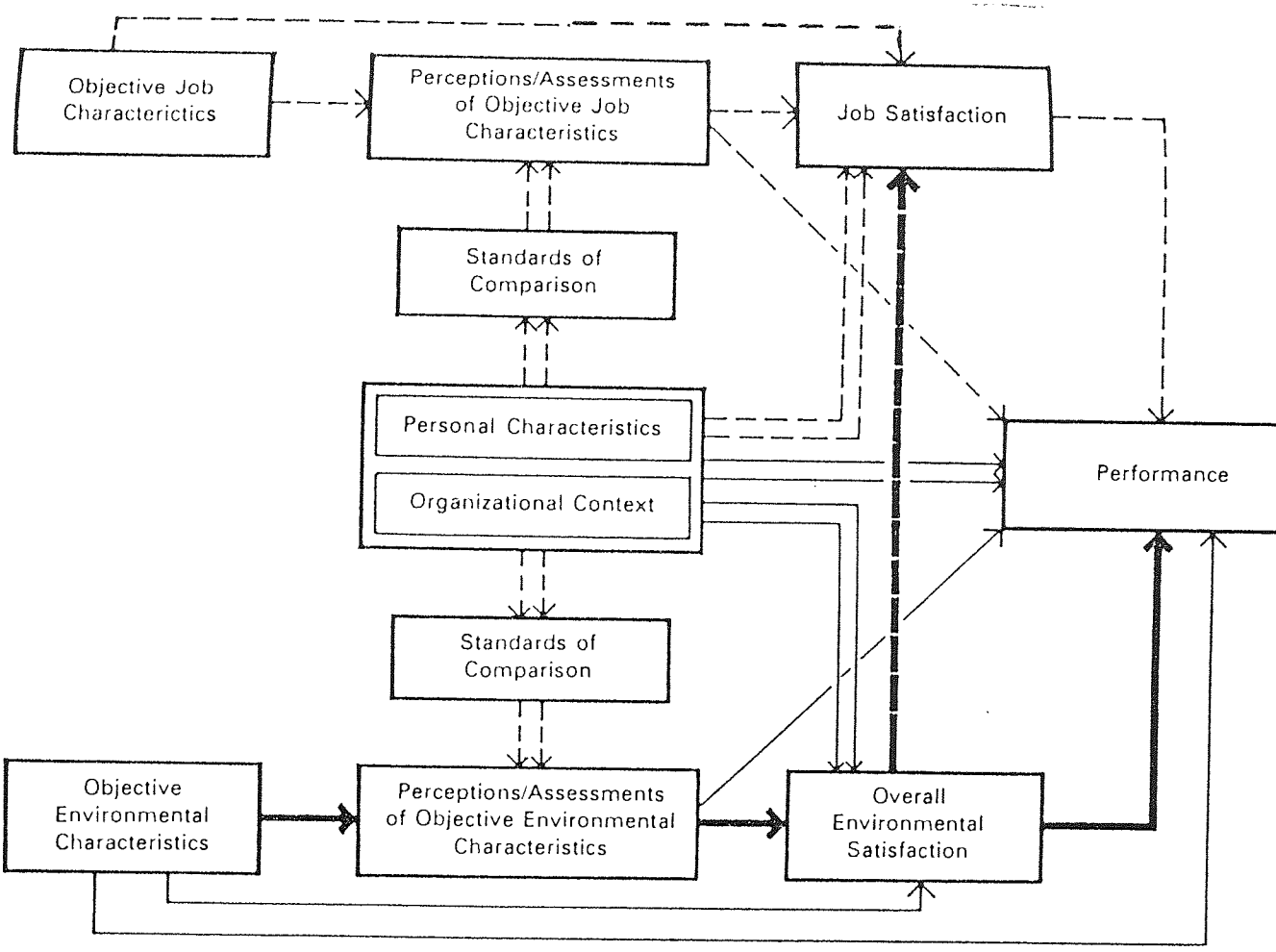
1.2.20 The overall environmental satisfaction for a worker is dependent upon four main factors:-

1. the job characteristics of the worker influence how they evaluate the work environment; a clerk and a manager working in an open-plan office will have different views about it,
2. the organisational culture influences the views of the workers; worker/organisation relations, the management style, social relationships,
3. the dependence of the individual's perception upon their own specific attributes,
4. the objective attributes of the work environment.

1.2.21 These selected instances indicate the breadth of inter-related nature of the "total" man-machine model and present a problem of dis-integration of knowledge in the research into office workers situation. The problem is that the different levels of analysis - the workstation impact, the office work area, organisational characteristics - require integration. Out of numerous potential variables a selection has to be made to reflect the complexity of these effects.

1.2.22 The inter-relationships between these aspects

Based on the models others have used (Chadrow 1983, Turner and Karasek 1984, Kahn and Cooper 1986, Motowidlo et al 1986) a model was developed for this study to describe and investigate the relationships of the interacting components of the individual, job characteristics, and office environment. The model is described in chapter 4.2 and suggests the causal orderings among the variables investigated.



Note: Bold lines suggest relationship important to environmental designers. Broken lines represent relationships that w not examined within the case study in this article. Double lines denote characteristics of organizations and their indiv workers.

Figure 1.4 A model for evaluating work environments (Marans and Spreckelmeyer 1986).

2. INFORMATION TECHNOLOGY IN THE DEPARTMENT OF SOCIAL SECURITY

Chapter Summary

A brief outline of the computer implementation programmes in the Department of Social Security is given.

2.1 GENERAL BACKGROUND

2.1.1 The social security work of the Department of Social Security is extremely complex and over the years has become increasingly unwieldy as benefits have been amended and extended. There are approximately 30 benefits with claimants exceeding 20 million in number.

2.1.2 The two large central offices of the Department at Newcastle-upon-Tyne and North Fylde have, for many years, used batch processing main frame computers. In recent years use is beginning to be made of information technology in the form of micro-computers in local offices to aid in calculating supplementary benefit (now Income Support) entitlement. In 1982 an overall strategic plan (DHSS 1982) was published, this described a number of separate computer projects which will build up a complex national network, integrating central and local offices. The programme of implementation will take place over 20 years at an added investment of £1700 million.

2.1.3 The network is comprised of 4 main projects:-

1) Local office project - each DSS local office will be linked to one of a number of large main-frame computers in four regional Centres. Local office staff will have

access to the mainframe via a VDT.

2) Terminal Replacement and Enquiry Service in the Unemployment Benefit Offices is now fully operational. Staff use VDTs with online access to the current computer centres at Reading and Livingstone. The NUBS2 strategy system is being designed to replace this system.

3) Departmental Central Index - local office staff will have VDT access to the departmental central index at Newcastle Central Office.

4) Replacement at Newcastle of the existing retirement pension system. The batch processing system will be superceded by on-line enquiry and up-dating systems.

2.1.4 In addition, systems have been developed to support many of the departmental administration and management functions. Automated office systems to aid decision-making in policy areas and in routine administrative tasks are being piloted. There are plans to extend and replicate successful pilot projects, with a phased implementation of new telecommunications links leading, in the early 1990's, to an integrated information processing system.

2.1.5 The research programme took place at four opportunity sites within DSS. One is representative of the Social Security strategy project - the Retirement Pension update project; one is computerisation of tracing and amending records at the Child Benefit Centre (Child Benefit On Line System (CBOL)); the other two are automated office systems being piloted at the Office of the Chief Adjudicating Officer, Southampton and at the Headquarters Division of the Regional Directorate in London.

3.REVIEW OF PREVIOUS RESEARCH

Chapter Summary

The previous literature on field studies into VDT use is reviewed. The major findings are summarised and the methodological weaknesses discussed.

3.1 INTRODUCTION

3.1.1 The results of the previous research into the implications of VDT use are organised in accordance with the research emphasis into the three areas of visual function effects, musculo-skeletal effects, and attitudinal responses. The discussion is limited to the main findings, and the description of the methodology is kept to a very restricted number of points.

3.2 VISUAL EFFECTS

3.2.1 VDT users frequently report the presence of eye fatigue and a number of other symptoms such as burning, itching or irritated eyes, and to a lesser extent blurred vision and changed colour perception. Previous studies have collected data on subjective reports of eye discomfort and/or objective measures of ocular and visual parameters. The evidence of statistically significant differences, however, between users and non-users is equivocal. Many of the studies suffer from flaws in methodology (Dainoff 1982, Rinalducci et al 1983, Grandjean 1987) which make the results difficult to interpret (Rinalducci et al 1983). In addition, the objective evidence of visual dysfunction

related to VDT use is less consistent than the subjective data.

3.2.2 Two early studies (Hultgren and Knave 1974, Gunnarsson and Ostberg 1977) employed both subjective measures and physical measurement of the office environment. Neither of the studies employed a control group. In the earlier work there was a majority of the 17 VDT users who complained of some visual problems, whilst in the latter it was 75% of the intensive users who complained of some visual discomfort at least a "few times a week"; the predominant symptoms in the latter study being eye fatigue (60%) and burning eyes (48%).

3.2.3 The study by Cakir et al (1980) was of a large sample of users across 30 organisations. The report summarises the findings related to visual disturbances. It has only limited details about the relationship of the visual effects and the variety of tasks and jobs that the users were engaged on. Compared to the large user sample of 1005 there was only a small group of non-users. The enquiry took account of the physical ergonomic aspects of the office environment and the workstation. There was a range of experience among the respondents with data acquisition VDT users indicating the highest levels of visual problems (85%), whereas programmers had much lower rates, ranging from 50% to 64% of that group.

3.2.4 The users employed by a Swedish newspaper and 30 directory assistants in the Swedish Telecommunications Administration were studied by Gunnarsson and Soderberg (1980). There was no control group but an experimental manipulation allowed comparisons to be made between a group

of users who spent approximately 4 hours per day on the VDT and a more prolonged period of use, 6 hours a day. The amount of eye problems that were found increased from 34% for the lower duration users to 63% for the other group. The main symptoms were eye fatigue and aching eyes.

3.2.5 A larger study was reported by a New Zealand group of researchers (Coe et al 1980). The users (257) were engaged on different tasks, data input, editing and programming and were compared with 124 manual office workers as a control group. The measures included optometric tests, objective anthropometric and ergonomic evaluations but unfortunately these were only completed for the VDT users. There were no difference found between the users and non-users in the proportion reporting visual discomfort and what is possibly more telling, the same situation was found for the optometric tests. However, there was a difference found between the various task groups who were using VDTs. The programmers group had fewer eye problems than the more routine and tightly structured jobs.

3.2.6 A further study using a control group was reported in the same year from Sweden (Johansson and Aronsson 1980). They examined the user's perceptions of their job attributes, job attitudes, and reported strains. Of the 81 VDT users there were 58% who had eye problems during the preceding year; though the details of the specific nature of the symptoms was not given nor a comparison made with the non-users on this area of the survey.

3.2.7 The results of a number of studies into visual symptoms were presented at an international conference held in Milan and the papers were published in the same year by Grandjean and Vigliani (1980). A variety of methodologies were used including physiological measures (heart rate, laser optometry, vision battery, skin temperature), interviews and questionnaires gathered data on the VDT user's views of the working environment, health symptom level, and workstation characteristics. Changes were found in the level of visual acuity for VDT users but not traditional office workers (Haider et al 1980) and also Ostberg (1980) found that air traffic controllers, who use VDTs very intensively, had a greater degree of accommodation response than less demanding VDT jobs; they found no such changes occurring forthe traditional office worker. In a similar comparison of 62 VDT users and 237 non-users, Ghiringhelli (1980) found that there was significantly more discomfort reported by the users; 75% saying that they had some eye disturbance. Visual discomfort was found to be clearly linked to physical viewing aspects of the tasks when comparing 109 VDT users, 55 traditional office workers, and 78 conventional typists (Laubli et al 1980). Elias et al (1980) also found that higher levels of visual discomfort occurred among the high speed input users than among the 81 less intensive dialogue users; 43% vs 21% blurring, 82% vs 69% discomfort glare.

3.2.8 In 1981 some North American field studies were being reported. An interview technique was used in one (Dainoff et al 1981) and a questionnaire in the other (Smith et al 1981). The latter study collected data from 125 professional

VDT users, 129 clerical level users, and 157 clerical controls whilst the former interviewed 121 clerical users. Dainoff et al (1981) received comment from 75% of the users about the poor lighting, the need for spectacles, or eye fatigue. Eye fatigue and the lighting problems were positively correlated with estimates of the proportion of time spent using the VDT (r=.28 and .39 respectively). The majority of the clerical users (91%) said that they experienced some eye strain in the other study, with the traditional clerical workers averaging about half that incident level. The professional users had lower levels of discomfort than the clerical users but more than the ordinary clerical workers.

3.2.9 A study of 63 newspaper professionals (Sauter et al 1981) were compared with a control group of professionals doing similar work but without thwe use of a VDT, using a questionnaire to ascertain their physical and emotional well-being. A greater percentage of users were reporting eye symptoms than the non-users; 33% vs 11% burning eyes, 30-40% vs 15-20% tearing, strained, and heavy eyes. There was no indication that there was any confounding effects by other group differences.

3.2.10 Smith et al (1982) concluded that there was no relationship found between the number of hours in the day that the user worked on the VDT and the prevalence of eye discomfort. This study also replicated one of the conclusions of Dainoff et al (1981) a year before, when the ophthalmic investigation failed to have a statistically

significant relationship with the questionnaire indices of visual disturbance.

3.2.11 Another useful comparison between two groups working on similar jobs was completed by Starr et al (1982) when a questionnaire survey of 250 telephone directory VDT operators were compared with 105 telephone directory operators who worked with hard copy directories. In addition to the usual biodata, the questionnaire elicited views about the worker's physical discomforts and their job satisfaction. No significant difference relating to eye problems was reported between the two groups.

3.2.12 A much larger study than the Berlin Group's (Cakir et al 1980) was conducted by the Canadian Labour Congress (1982) when data from 11,742 VDT operators was compared with 588 non-user controls from 15 sites across Canada. The information gathered was about the workplace ambient conditions, workstation characteristics, health disturbances and the job characteristics. The users represented four categories of VDT user: data entry, production line, conversational-clerical, and professional-technical. Items of the questionnaire dealing with visual problems reported by the users were significantly greater than the control group. The users reported the frequency of the discomfort's occurrence - daily, weekly, monthly and this was generally about 15-20% for the users, and 10-12% for the non-users. The increases in the problems reported were related to the reported VDT screen problems of flicker, blurred characters, as well as keyboard glare, and indifferent maintenance. The professional-technical users were found to have the lowest

level of visual disturbance, as was the case with the Smith et al (1981) study.

3.2.13 At this point in research knowledge, a detailed review of field surveys by Rinalducci et al (1983) concluded that VDT work per se did not produce more visual complaints than comparable non-VDT work, and the causal factors underlying the complaints of workers regarding visual difficulties had not been established. The latter view was supported in a paper reviewing the physical ophthalmic issues (Campbell and Durden 1983). There was still an unanswered question concerning which aspects of visual tasks might contribute to the experience of ocular discomfort sometimes reported by the VDT and non-VDT workers.

3.2.14 A longitudinal study using a repeated measures design by De Groot and Kamphuis (1983), in which they used physical ophthalmic measures as well as a subjective questionnaire to assess the degree of ocular complaints, concluded that the severity of complaints were about the same in the non-VDT and VDT situations. There was little change apparent after two years on the VDT. A study of four types of clerical workers (Howarth and Istance 1985) using two sets of matched pairs of VDT users (word processor operators, data preparation) and non-users (typists, general clerical) for control purposes came to the same conclusion as Campbell and Durden (1983). They used similar measures to De Groot and Kamphuis, but on a daily basis during a single working week. Hedman and Briem (1984), measuring eye accommodation and convergence, found no main factor

differences between workers over a three month period on a job rotation procedure and a further three months on a non-rotation schedule.

3.2.15 The office environment came in for close attention by Mauli and Bellucci (1984) in a study of white collar personnel in an Italian public authority. The temperatures, relative humidity, ventilation, air speed, and the chemical and bacterial composition of the air in various rooms in the organisation was measured. They concluded that these parameters had been established as important and related factors to visual discomfort of VDT users. The same researchers examined the ergonomic parameters of the users' workstations in relation to the ophthalmic measures and found them to be strongly correlated; with no correlation with the visual performance of the users (Mauli and Bellucci 1984). In the same set of published papers, edited by Grandjean (1984), Sauter reported the results of a field survey of office workers using VDTs and a control group. Using regression analysis he found that a number of factors contributed to the reported eye strain; age, use of corrective eyewear, ambient lighting, display image problems. All of these factors have been linked previously, but he also found a pronounced effect for a general psychosocial-organisational factor, job control.

3.2.16 A number of cross-sectional studies continued to find that the VDT user, when compared to the non-user, reported more frequent visual problems (Rowland 1984, Travers and Stanton 1984, Knave and Bergquist 1985, Knave et al 1985, Levy and Ramberg 1987, Stellman et al 1987). The

evidence was also becoming clearer that there were important variables relating to the type of work that the user was engaged on; data entry work and telephone service personnel were found to have more eye irritation than mixed office workers using VDTs and eye fatigue was associated with the amount of time spent on the VDT (Levy and Ramberg 1987). The amount of time spent at the VDT was also found to be an important parameter for ocular symptoms by Rubino et al (1987) and reported at the same conference.

3.2.17 At the Volvo car company in Sweden a study of the medical, social and technical aspects of working with VDTs was undertaken to "eliminate the unsatisfactory aspects of the work environment" (Wright 1987). A small group (N=21) of "extensive" users and a similar sized group (N=18) of "limited" users were studied on a longitudinal basis, 12 months before and 12 months after working on a VDT. The extensive users spent more than 3 hours a day working on the VDT, a third of them as much as 7 to 8 hours a day. Eyestrain was twice as common at the post implementation stage for the extensive users than for the limited users.

3.2.18 Grandjean (1987) reviewed seventeen surveys which included data on visual discomfort and found that the majority had shown an increased incidence. He did comment, however, on the lack of scientific rigour in the methodologies and selects the choice of control groups as probably the most significant shortcoming. He postulated that if the control groups are engaged on traditional office work, with low productivity and a greater variety of tasks, they seem to be much less affected by visual discomfort

than the VDT groups. On the other hand, where the control groups do high speed work lacking in variety and poor reading conditions, the complaints of visual discomfort are as frequent as among the VDT users.

3.3 MUSCULO-SKELETAL EFFECTS

3.3.1 The research findings are inconclusive regarding the greater prevalence of musculo-skeletal symptoms among VDT users as opposed to the non-users in similar jobs. However, there is a considerable amount of subjective and objective data on physical anthropometric and ergonomic features of the VDT workplace but the relationships with the reports of musculo-skeletal symptoms are not very common. Although users report the incidence of musculo-skeletal symptoms it is generally at a lower level of frequency than with eye symptoms. Studies have found that the common symptoms are neck, shoulder, and back discomfort. These features have been attributed to poor body posture and incorrect seating position during the use of the VDT (Cakir et al 1980, Hunting, Laubli and Grandjean 1980, Campbell and Durden 1983, Rinalducci et al 1983, Grandjean 1984).

3.3.2 Among the earlier studies into musculo-skeletal discomfort, Gunnarsson and Ostberg (1977) found that 65% of the VDT users, in a customer service section of a Scandinavian Airline, complained of discomfort in the shoulders, neck or back. Although the workstation had adjustable features it was apparent that the users failed to take sufficient advantage of them. There was no non-user group included in the study.

3.3.3 Back problems were reported by 57% of a sample of 378 VDT users, and 24% complained of neck and shoulder pains in a study referred to briefly by Cakir et al (1980). They make comparisons of different office workers - copy typists, information typists, traditional clerical workers, programmers, editors and concluded that VDT users are not uncommonly suffering from musculo-skeletal discomfort but, not withstanding the variation in tasks included in the survey, they appear to suffer to about the same extent as non-users. They listed visual, motor, and temporal task demands, ergonomic aspects of the VDT, length of service at the VDT, and the extent of daily use as the main determinants of musculo-skeletal discomfort. A much smaller proportion of the sample (11%) had musculo-skeletal discomfort in the New Zealand study (Coe et al 1980). Unlike the visual aspects of the study, a control group comparison was not reported, but the degree of complaints was higher in the data input (19%) than in the creative (13%), editing (9%), or dialogue (8%) groups of users. Adjustable seating was associated with increased chair discomfort, but the seating height was found to be incorrect relative to the existing standards. In this area it was reported that the users (37%) said that they had seating discomfort, whilst a significantly lower percentage of the non-users had a similar complaint (26%).

3.3.4 Both objective and subjective data on musculo-skeletal discomfort was obtained by Hunting et al (1980). The overall level of complaint was approximately a fifth of the visual complaints. Data entry users (15%) had the highest frequency, with conversational users and traditional

typists slightly less (4%-11%), with traditional office workers the least (1%). These proportions were supported by the medical examinations that were carried out. The relationship between the height of the work surface and the main statistically significant complaints was that the more elevated surfaces were related to less impairment.

3.3.5 Two contrasting studies to those just described reported, on the one hand, a greater incidence (between 40% and 50%) in the sample population (Elias et al 1980) and, on the other, a smaller level (under 10%) of back and neck pain (Ghiringhelli 1980).

3.3.6 A lot fewer musculo-skeletal discomforts were found by Dainoff et al (1981) and those that were reported, however, were consistent with previous reports. A group of users were asked, before and after a day's work, about a physical symptoms checklist and they reported a smaller increase in the musculo-skeletal discomforts than for the visual symptoms. The clerical VDT users in the NIOSH study (Smith et al 1981) reported more symptoms of a musculo-skeletal nature than previously found in the other studies. As before, the main categories were for neck and shoulder pains (78%), back pain (78%), with arm and hand problems ranging between 33% and 49%. In keeping with both the Berlin (Cakir et al 1980) and New Zealand (Coe et al 1980) studies the findings suggested that the clerical VDT users experienced greater degrees of musculo- skeletal discomfort than the professional users, though no comparison data was given.

3.3.7 Links were studied between the workstation features and the respondents musculo-skeletal discomforts in another NIOSH report (Stammerjohn et al 1981). There is only summary data given, which shows that the users did not find the screen or keyboard particularly troublesome but the researchers indicated that there was an association between these factors and the musculo-skeletal complaints in the case of the professional users only. The clerical users rated the comfort of the chair significantly less comfortable than the professional users or the control group.

3.3.8 Sauter et al (1983) found that news editors had as high an incidence of back and neck or shoulder complaints (85%) as the clerical users reported by Smith et al (1981). Examining the neck and shoulder discomfort levels in isolation, the VDT users had a much greater incidence than the clerical group. The number complaining of the discomfort of their chair was similar to the levels reported by Stammerjohn et al (1981); only 40% stating that they were comfortable.

3.3.9 The only differentiation that Starr et al (1983) found among the 250 telephone directory operators who were using VDTs and the 105 who worked only with hard copy was neck discomfort. Any significant differences between the groups disappeared when the researchers matched two subsidiary groups for age. Despite the lack of any other significant differences the VDT users were reporting back, neck, and shoulder discomfort at much higher incidence levels (48%-65%) than for arm or wrist pains

(approximately 10%).

3.3.10 Similar numbers of the VDT users in the Canadian Labour Congress study (1982) reported musculo-skeletal discomforts; about 40%-59% for the neck, shoulder, and back symptoms. The non-users were reporting significantly fewer occurrences for the neck and back pains. They found a relationship between the amount of time that the respondents reported they spent sitting, though complaints about the adjustability of the chair and the VDT screen angle were not related.

3.3.11 Research in a Belgium bank by Gobel and Meers (1983) compared the findings on the physical office environment, workstation ergonomics, and the psycho-social environment between full-time VDT users, part-time VDT users and manual office workers. The number of health complaints were proportional to the amount of VDT work, with general physical discomfort and back pain. They found significant shortcomings in the ergonomic criteria of the workstations but considered that the content of the jobs, which were devoid of variation, was as much a contributory factor to the health problems. Sauter (1984) found significant associations of musculo-skeletal problems with both gaze angle to the screen and the adjustability of the keyboard; the strain scores increased with the increasing gaze angle, and were reduced for the VDT users that had detached and adjustable keyboards. Using regression analysis he found the chair comfort rating predictive of musculo-skeletal problems (standardised regression coefficient = -0.21) but found there was a greater effect from the psycho-social variable

of job control on upper torso problems (standardised regression coefficient = -0.26).

3.3.12 Rowland (1984) conducted a study with a similar population to Starr et al (1983) of telephone operators; 145 using VDTs and 156 without. The VDT users were found to be four times more likely to report neck pain and aching eyes, but no association was found between the VDT and musculo-skeletal postural problems. Unusually several measures for musculo-skeletal pain (self completed questionnaire, a medical examination, and physiological monitoring) were used for a population made up of three types of office VDT user and two types of non-VDT office worker by Zeier et al (1987). They found that the VDT workers did not report significantly higher amounts of musculo-skeletal discomfort and they concluded that the entire work environment is critical for these disorders and not the VDT per se.

3.3.13 In the Volvo car company longitudinal study by Wright (1987) it was established that the extensive users had experienced an increase in musculo-skeletal problems over the period of the study but for the limited users they had remained constant. The changes were not restricted to the introduction of the VDTs. Other changes were involved to the job content and customer demands, so the impact by the VDT is compounded by other factors and the results therefore need to be interpreted cautiously. The Stellman et al (1987) study also found that the group who used the VDTs more frequently (over 4 hours a day) reported significantly higher levels of musculo-skeletal complaints, though this

was a cross-sectional survey it had the advantage of being a much bigger population across several organisations.

3.3.14 It is clear from the field surveys that the causes of the greater incidence of musculo-skeletal problems that are frequently found among VDT users is complex but the commonalities with other office machine users suggest that constrained posture is a major contributor. The number of fixation points in VDT work (e.g. keyboard, screen, document, chair, desk) limit viewing and if the job is high volume, low variety, there appears to be greater risk of physical discomfort. Brown et al (1982), summarising the discussion at an American symposium on vision and VDT work, suggested the solution to most workstation design problems are known and can be applied. Some of the studies referred to above found no significant differences between the VDT users and the control groups. This raises the same issue as was touched on in the former section on visual effects, the control groups are not always directly comparable and the results therefore have to be viewed with some caution. Other studies have not used control groups which raises even more serious reservations about their findings. In a comparison of four studies which had looked at different types of VDT use, Grandjean (1987) observed, though unable to make a statistical analysis, that arm, shoulder and hand discomfort were observed in each group but it was in the data entry group that the highest incidence occurred and the lowest figures were reported by the CAD operators and the control group engaged in traditional clerical work. "It is striking that the three groups whose work is characterised by a great diversity of body movements clearly present the lowest

incidence of physical discomfort" (Page 110, Grandjean 1987).

3.4 ATTITUDE AND PSYCHO-SOCIAL FACTORS

3.4.1 Introduction.

3.4.1.1 The main areas reported on have been the general level of job satisfaction, the perceptions of the job content, and the levels of stress. With regard to the latter, there are equivocal findings; some studies establishing that the VDT jobs can be mentally fatiguing, with users frequently irritated by the problems related to the performance of the system. There are a growing number of studies which examine the job content but a number indicate that the jobs which have poor profiles and are viewed as monotonous, routine, highly controlled, and low skill levels have been eroded further by the introduction of VDTs. Jobs which have much better profiles have been less affected. If there was an improvement in the performance of the work area where the computers were introduced there had generally been no desire to return to a non-computer environment; though in those studies where there have been comparison groups the evidence pointing to a deterioration in job content is equivocal.

3.4.2 Office Workers

3.4.2.1 As in the earlier studies referred to, the majority of the 45 users in the Swedish Telecommunication Administration (Gunnarsson and Soderberg,1980) found that the computer system improved their efficiency in the job

through faster data handling, simplified procedures, and thereby more effective service to their customers. The disadvantages seen by the users were due to non-involvement in the system's design, and the system's technical shortcomings.

3.4.2.2 A questionnaire measuring quantitative and qualitative overload, task feedback, variety, cooperation, relationships with colleagues, decision latitude, and utilisation of skills was obtained by Hunting et al (1980) from 54 VDT clerical users and a control group of 55. The VDT respondents considered that they had less variety and a greater workload than the control group, with no significant differences found on the other measures. Job content differences were attributed to be the reason for contrasting scores on indices of personal well-being in two VDT user groups; 89 off-line data acquisition users and 81 conversational users (Elias et al 1980). The off-line jobs were more repetitive, with lower levels of control and decision making. These different features led to three indices of mood alteration showing mean incidence levels of 60% for the data acquisition group and 50% for the conversational users, whilst on four measures of psychosomatic disorders 45% vs 20%, and troubled sleep 45% vs 15%.

3.4.2.3 The workers in the Skandia Insurance company surveyed by Johansson and Aronsson (1980) perceived their jobs quite positively, with only 25% of the VDT users seeing their work as monotonous or too demanding. The majority of the users and the small control group thought that they had

moderately challenging jobs with a reasonable degree of autonomy. An excessive workload was reported by this group (80%) but none of them wished to return to the former non-VDT jobs. There did emerge concerns among them on a wider set of issues about the future direction of computerisation and the possibility of skill obsolescence in the future. A little over 50% considered that job impoverishment, particularly increased monotony,and breakdowns of the computer system were the major disadvantages. The uncertainty created by the breakdowns, as well as the actual impact on the work processing, were two of the three main factors attributed by the respondents to causing occasional or frequent strain, the other factor being work overload. A small decline was reported in the level of variety of tasks, found to a greater degree in the data entry group than with the customer service jobs.

3.4.2.4 A number of physiological measures were taken from a small group (N=11) out of the main sample of VDT users and a control group (N=10). The control group were not performing the same jobs in that they were mainly typists and secretaries with 50% of them using the VDT for limited periods only. The catecholamine excretions (adrenaline and noradrenaline) were moderate in both groups in relation to other occupational groups that had been studied. It was clearly established that the VDT user group had higher adrenaline excretions during the working day than at home and this effect did not occur in the non-users. In addition, the adrenaline levels were higher in the users than the non-users during both the work day and at home; this correlated with a greater degree of mental strain felt at work, and

fatigue experienced at home at the end of the day by the users. It was particularly interesting to also find that the adrenaline excretion also reflected the self imposed workload pattern which was chosen to cope with the system breakdown uncertainty; the users tried to press on with the greater amount of their interaction with the computer in the morning, in order to accomplish as much work as, possible in anticipation of potential system problems later in the day. It was also found that increases in adrenaline and diastolic blood pressure occurred during periods of breakdown compared to measures taken at similar times on other days. A parallel increase was reported by these subjects (N=6) in their feelings of irritation and a decrease in relaxation.

3.4.2.5 Depressive disorders and anxiety state were found to be high among 77 VDT users by Ghiringhelli (1980). The data from a control group were, however, not indicated and the results are not clear in that the number of complaints are mentioned and not the number of users. The users on the whole, unlike the users in a number of the other studies mentioned, viewed the computer system in a negative way citing concerns over machine dependence, monotony, isolation and health impairment. The more positive attitude to computers was found in the Dainoff (1980) study of 121 VDT users, 81% appreciating the assistance the VDT gave them in their jobs, though almost 50% considered that there were technical problems with the computer. The positive attitude to the computer still did not prevent about half of the users commenting on the stress and fatigue they felt at work.

3.4.2.6 Using a measure of mood state (McNair et al 1971) at the commencement and termination of the working day, Dainoff et al (1981) found that fatigue and tension were greater at the end of the work day, though there was no effect related to the total working week. The adverse effects on job quality were shown to be at the clerical level in the large NIOSH study (Smith et al 1981) confirming the implications of the work up to that date. The clerical users' mean scores were well above the clerical control and the professional groups scores on indices of boredom, workload dissatisfaction, role conflict, and future ambiguity. On a further 16 individual questions relating to monotony, job control, work pace and load demands, the social environment and career future opportunities, the clerical users were in the poorer job profiles with the most favourable responses coming from the professionals. The NIOSH researchers, however, in contrast to the Dainoff et al (1981) findings, and using the same profile of Mood States instrument (McNair et a1,1971), did not find any increase in the mood state of the VDT users. The VDT users were more likely to link personal problems and stress to their work than did the other two groups.

3.4.2.7 The Canadian Labour Congress (1982) enquiry found six symptoms of an adverse nature on the mental well-being measure to have significantly higher incidence rates among the VDT users. The most frequent symptom was that of fatigue (27% users, 20% non-users). The users were also reporting higher job pressure (47%-38%), and less job satisfaction (60%-65%). As with the NIOSH study the problems were less pronounced for the professional group of users. The level of

incidence increased also with adverse reports of computer monitoring of work performance, of excessive noise in the office, and strong feelings of isolation.

3.4.2.8 Using the Job Description Inventory (JDI) (Smith et al 1969) Travers and Stanton (1984) report that there was no statistically significant differences between users and non-users in their cross-sectional study on the work satisfaction and job satisfaction dimensions of the inventory. They did, however, find that there was a significant difference in terms of co-worker satisfaction, with the non-users expressing less satisfaction than the users. Even though the users had lower scores than the non-users for depression, tension, and anger they didn't reach statistical significance.

3.4.2.9 The report of the 1986 conference "Work with Display Units" contained a number of papers addressing the psychosocial issues. A comparison of data processing users by Bradley (1987), on three types of system (batch, on-line, micro-computer) and a group of non-users, found the users generally more dissatisfied with irregular work pace, the dependence on other people, and the high workload. They were presented with a picture of the technology having increased the rate at which work was performed and the material processed, which also increases the pace required for the completion of other functions. The greater daily users of the VDTs experienced a negative effect on their ability to receive both formal and informal feedback from the job. However, on the positive gains they worry less about making

mistakes. Unfortunately no detail is given of the statistical analysis and data, as well as information about the non-user population.

3.4.2.10 Wright's longitudinal study at Volvo (1987) reported that the users found their jobs too simple, monotonous, and restricted by the computer. Depression had increased over the 12 months of the study but the measure of psychological insufficiency and psychosomatic symptoms remained "largely unchanged". Absenteeism, though low for the users, generally had a higher incidence among the "extensive" users. The extensive user group in Stellman et al's study (1987) report the highest mean levels of negative workplace characteristics, such as repetitious work and latitude of decision making, and the lowest levels of development opportunities. The limited users were,however, closer in mean scores to the traditional office workers.

3.4.2.11 Aronsson and Johansson (1987) reported, at the 1986 conference, data from the 1984 follow up study to the work they reported in their paper in 1980. After the earlier survey they had recommended improvements to the technical system, mainly in order to reduce the incidence of breakdowns and an improvement in system response times, and to the job design, in order to reduce the amount of data entry work and the reliance of individuals on the computer to complete their work. In 1984, 71 of the 95 users in the 1977 sample were respondents and expressed better possibilities of alternating between parallel tasks, which allowed flexibility of task completion at the time of computer breakdown. Their repetition of the physiological

measures found no difference in the blood pressure levels of the VDT users and the non-users. They were able to conclude that, due to the work reorganisation, the amount of VDT work had moved towards "a middle of the scale" for high and low users of the earlier survey, and therefore the assumption that computerisation is associated with further and undesired work division is not supported.

3.4.2.12 Using a major part of the questionnaire employed by Smith et al (1981) and Sauter (1983), Gardner et al (1988) surveyed a population of U.S. Naval civilian administrative and clerical staff, both VDT users and non-users. The users, both occasional and frequent, scored higher on the boredom measure than the non-users. The frequent users also scored higher on the role conflict factor and perceive that they are expected to work faster and harder than the occasional users. Comparing Smith's clerical users and Sauter's users, Gardner's users scored higher on quantative workload, role conflict, workload variance and workload dissatisfaction. On these variables the Gardner users' scores were also higher than the other researchers' non-user scores, except for Sauter's non-users on workload dissatisfaction. On the Profile of Mood States (McNair et al 1971) there was no significant difference among the three navy groups, as Sauter et al found, though Smith et al did have the clerical users reporting more fatigue than the professional users or the traditional office workers.

3.4.3 **Customer Service Work**

3.4.3.1 The degree of variety in the jobs of customer service VDT users was evaluated in the Scandinavian Airline jobs studied by Gunnarsson and Ostberg (1977). There was a strong consensus among the 39 VDT users that the jobs were monotonous, and they agreed that the enlargement of the job to include other tasks, or rotation onto other jobs, would be welcomed. "Many" users reported the need for greater control over their work pace, this and the need for greater privacy were regarded as the main causes of stress by the respondents.

3.4.3.2 Moderate to high levels of VDT user job satisfaction was found by Starr et al (1983) among 250 VDT directory assistance operators and 105 hard copy control subjects. The users exceeded the control group scores on the work, promotion opportunities, and people satisfaction dimensions of the satisfaction measure which was used (Job Descriptive Index-Smith, Kendall and Hulin, 1969). Users also reported higher satisfaction with regard to wholeness of task and work pace control.

3.4.3.3 Rowland's survey (1984) of telephone operators, with similar job holders to those reported on by Starr et al (1983), found 40% of the VDT users felt that they were under high job pressure and were significantly ($P=<.0001$) dissatisfied with their work. The users reporting a high work load were four times as likely to experience health problems. The contrasting results to the Starr et al VDT users, who considered that they were offered some degree of

flexibility in the pace of work, could be due to the workload pressure felt by the users in the later study. High workload, and the monotonous nature of the job, were also regarded as the main contributory factors in a qualitative study in a Belgium bank (Gobel and Meers 1984). Job satisfaction, for those users that were working exclusively on VDTs, was poor and the researchers attributed this to low self esteem; they found the work didn't require much capability and others regarded the jobs as inferior.

3.4.3.4 Surveying 189 travel agents in the Greater Manchester area, Kahn (1987) concluded that general job satisfaction was higher among the users of computers though there was no difference in the users' jobs being more motivating. He found however, from the Job Diagnostic Survey (JDS), developed by Hackman and Oldham (1975), that the users who had worked in the traditional method in a travel agents scored higher on all the job characteristics, other than task identity. He suggests that this may arise due to the non-users feeling that they are being "left behind" by their peers. Unfortunately the response rate was very low so the results obtained need to be viewed with caution.

3.4.4 **Word Processing**

3.4.4.1 Hedge and Crawley (1982) used the JDS (Hackman and Oldham 1975) and found distinct differences in job content between word processor operators and traditional typists in the University of Aston, but the job satisfaction measures that they used do not show any significant differences. These researchers report a similar study by Krois and Benson (1980) using the JDS with results of a similar nature and

those authors conclude that job satisfaction seems to be more strongly influenced by the characteristics of the organisation than by the changes in job content arising from the use of word processors.

3.4.4.2 Job satisfaction and stress were measured in another UK comparison study between word processor operators and conventional secretaries (Cooper and Cox 1985). The measures used were the Brayfield and Rothe (1951) job satisfaction scale, the Crown -Crisp Experiential Index (Crown and Crisp 1966), and a survey specific set of work stressor factors. In a t-test comparison of the two groups, there were no differences on the overall mental health scores but on the job satisfaction scale the word processor operators were significantly less satisfied than the secretaries. A multiple regression analysis of the work stressor variables on the mental health index found the most significant predictors to be the lack of role clarity, overwork, forced to meet tight deadlines, undervalued by their bosses and limited career prospects. The lack of role clarity also emerged as the most significant predictor for job satisfaction; accounting for 21% of the variance.

3.4.4.3 The more frequently cited study of Buchanan and Boddy (1980) also examined the changes brought about by the introduction of word processing equipment. The typists' jobs were found to change in respect of task variety, work cycle, feedback of results, and skill/knowledge demands. Rafaeli and Sutton (1986) examined three groups of clerical workers who used word processors and/or typewriters. Using the autonomy scale from the Hackman and Oldham JDS (1975) as the

measure of general work control they report that the WP operators considered that they had greater levels of control than the typewriter users and the ease of use items are positively related to workload control. These findings are in contrast to the observations of Buchanan and Boddy that autonomy is reduced by the new technologies.

3.4.4.4 Another study, examining the impact of word processing equipment on the job content of their users, employed a case study methodology to investigate the position, in three different organisations, prior to the use of the WP systems and fifteen months after the systems had been in use (Westlander 1987). The type of work selected for study was quite different in each organisation; there was an organisation development (OD) department of a local government authority,a personnel and training (PT) department of a private security company, and thirdly a public relations (PR) department of a state owned public utility. The changes varied in each case from virtually no change in document production procedures and minor work division changes in the OD department, with only minor changes in the division of work in the PR department, whilst the PT department had experienced more major change to their organisation and division of work as well as the document production process. The three departments had approached the change process differently, which had resulted in three different outcomes in the social psychological conditions. There was a full consensus in the PR department of how to find the best way of using the equipment, a partial consensus in the PT department, and non-consensus in the OD department.The remaining problems were also of a different

nature for each department; the OD users had high productivity overload with latent conflict existing between the users and document authors, the PT department had a number of system deficiencies, whilst the PR department had users with technical knowledge and skill deficiencies.

3.4.5 **Varied Work Profiles.**

3.4.5.1 The extensive surveys by Cakir et al (1980) used a large battery of measures to evaluate work stress, job satisfaction, level of arousal, mood or psychic state, personality characteristics, and achievement motivation. The level of stress found in five groups of users (off-line acquisition, on-line acquisition, supervisor, on-line enquiry, and programmers) was greater than found in groups of long distance lorry drivers, crane operators, and key punch operators. The comparisons are with the normative data of the scale authors, and there was no comparison with any equivalent non-user group. Fatigue in the studies was found to be related to the number of hours spent daily on the VDT. Fatigue was also strongly related to the jobs with poor levels of variety and task activity. They reported that clerical workers, who had been regraded to copy typists on the introduction of the on-line computer system, reported more monotony and fatigue than the other groups surveyed; unfortunately there is no report of where the differences lie between the different groups. Other evidence presented in the VDT Manual compared the differences in job content in three offices being related to perceived differences in fatigue, workload, monotony, and degree of responsibility.

3.4.5.2 A generally high level of job satisfaction was found among the VDT users and non-users alike in the study by Coe et al (1980). The users, however, felt that they had a higher degree of work pressure; 54% of the VDT users and 42% of the non-users, and this was particularly true of the editorial and creative staff compared to the data input and dialogue users. There was also some consistency with the Berlin study in that the professional staff took fewer breaks, smoked more, and engaged in less leisure activity. Some of the aspects which gave rise to the feelings of pressure were key stroke measurement for the data input users, and adaptation to the new work medium of the VDT for the editors.

3.4.5.3 Turner and Karasek (1984), in a paper focusing on the theoretical aspects of software design, refer to research by Turner (1980) of 1001 bank clerks using a computer system. He found that the clerks perceive workload as positively correlated with computer use and, along with task interdependence, are positively related to mental strain. Using that study, and other material from the literature, the paper argues that computer software can influence the characteristics of jobs, which will influence effectiveness and user well-being.

3.4.5.4 A comparison of computer aided design professionals with design professionals who didn't use computers in the same organisation, found none of the three job satisfaction measures that were used differentiated the two groups at a statistically significant level (Newton 1984). A hierarchical regression analysis showed that job

control, social support and office environmental problems accounted for 56% of the job satisfaction variance,whilst the number of hours on the computer in a day did not contribute towards the prediction.

3.4.5.5 A Finnish survey (Kalimo and Leppanen 1985) compared four occupational groups in the printing industry, some using VDTs for typesetting. They found that the use of VDTs for typesetting had increased the level of feedback and quality control in their work compared to the older technology of perforator typesetters. This raised the level of control over their work which is a striking contrast to the diminished control that many other VDT users experience. The mental activity and self-determination aspects of their jobs were viewed more positively by the VDT typesetters and photo-compositors than by the proof-readers and perforator typesetters; a reflection of the benefits that can be obtained from the most advanced technologies in that sphere of work.

3.4.5.7 Another Finnish study (Lindstrom and Leino 1989) carried out over a two year period looked at client service and office staff of two insurance companies and four banks. A questionnaire was completed before the respondents received new VDTs to assist them in their work and on a second occasion after they had been using the new computers for several months. Interviews were also conducted at intervals during the implementation stages and during the "settling in" period. The majority of the insurance workers were already using some form of computer assistance at the first survey but less than half of the bank's employees

were. The demands on memory were high for all the groups which increased during the two years of transition. Attention and psychomotor demands were also high and the work pace had increased for all groups. The changes came about, however, due to factors other than changes in the computer applications, such as the client centred groups having stronger market oriented economic goals. The researchers had not differentiated between these different influences and the new computer schemes, neither had they compared the effects of the changes on those who had not worked with VDTs in their jobs prior to the changes.

3.4.6 **Summary of Psychosocial Aspects.**

3.4.6.1. The evidence indicates that some aspects of the jobs involving VDTs are closely related to the use of the machine, such as the pace of the work and the amount of control afforded to the user through the software, whilst other features are independent of the use of a computer, such as supervisory control, variety of task, skill utilisation. Studies have only recently been examining the job design factors involved in the use of VDTs but there appears to be distinct possibilities that the problems associated with the use of VDTs have been confounded by the accompanying socio-technical and organisational systems.

3.4.6.2 The studies referred to in the preceding sections indicate that there is a great deal of latitude in the manner in which the computer system is used. Even within the above broad categories of jobs there have been found to be quite different experiences for the users. The studies where the clerical VDT user has regarded their work as more

dissatisfying or stressful than non-users can be ascribed to less variety, more monotony and boredom, lower control and decision making, and greater workload and job pressure (Gunnarsson and Ostberg 1977, Cakir et al 1980, Coe et al 1980, Hunting et al 1980, Elias et al 1980, Ghiringhelli 1980, Smith et al 1981, Canadian Labour Congress 1982, Gobel and Meers 1984, Turner and Karasek 1984, Cooper and Cox 1985, Stellman et al 1987, Bradley 1987, Wright 1987, Lindstrom and Leino 1989).

3.4.6.3 On the other hand many of the studies did not find lower levels of job satisfaction or higher degrees of stress. Johansson and Aronsson (1980) found some job impoverishment but after recommendations to improve the job content, they found in a subsequent study that the situation had improved. Dainoff (1980) found a positive attitude among the users, whilst no differences were found between users and non-users work and job satisfaction measures by Travers and Stanton (1984) and Newton (1984). Khan (1987), in the travel agent study, had higher measures for the motivating quality of the jobs of the users, and on a number of dimensions of satisfaction the users scored higher in the telephone operator study by Starr et al (1982); namely work and people satisfaction, wholeness of task and work pace control.

3.4.6.4 The introduction of word processing systems into different office environments examined by four studies point positively in the direction of the organisational characteristics having a more influential role than the computer system on the job content of the users (Buchanan

and Boddy 1980, Hedge and Crawley 1982, Rafaeli and Sutton 1986, Westlander 1987). The computerisation of the typesetting work in the printing industry clearly demonstrated how the advances in new technology can enhance the feedback and quality control in the user's tasks (Kalimo and Leppanen 1985) when compared to the traditional methods of typesetting. It appears that the jobs, even when there is a large element of VDT interaction, have been determined by what the worker is expected to produce, the methods and procedures to follow, the skills and abilities required and the social interactions. The range of possible sources of stress and dissatisfaction vary, as in non-computer jobs, with the added dimension of the use of a machine which is placed in the particular work context by the organisational decision making processes and culture.

3.5 THE METHODOLOGICAL WEAKNESSES

3.5.1 A number of researchers, and authors of literature reviews, have over the past decade drawn attention to the short-comings of many studies on the impact of VDT use on workers well-being. The major criticisms by these reviewers has focused on the points that are frequent problems and issues in field studies into worker's attitudes and well-being. A common issue relates to the fact that the great majority of the studies are cross-sectional, which does not help in clarifying the antecedent factors in the situation found in the study (Rinalducci et al 1983). There is a need to take measurements before as well as after the changes that introducing VDTs into the work environment brings. By considering only the current situation, as cross-sectional

studies do, any differences in the measurements that different groups have at an earlier pre-change date, ie prior to the use of VDTs, may remain present at the post-change measurement but be inappropriately attributed. For instance a clerk may well be experiencing discomfort from the lighting and poor furniture dimensions and layout, which has previously been ignored, and having received a VDT the problems remain but, in the light of the current debate, are measured and given specific attention as if relating only to the use of the VDT (Ivancevich et al 1983, Howarth and Istance 1985, Kahn and Cooper 1986).

3.5.2 The sampled populations eg clerical and professional workers, are sometimes not kept sufficiently separated in the analysis and the different work environments, such as professionals and clerical workers find themselves in, may also influence the well-being of the users, and are not taken sufficiently into account (Rinalducci et al 1983, Christie 1985, Hedge 1986). The low response rate and the self-selecting process of volunteer respondents completing self-administered questionnaires are two further problems which are possibly contributing to the different outcomes obtained in the studies (Rinalducci et al 1983, Hedge 1986, Grandjean 1987). This is particularly true of those studies with low response rates. In such circumstances it is not known if the respondents are the more disaffected of the population studied, and thereby a higher incidence of complaints about the VDTs can be estimated, or on the other hand, if only the most satisfied respond the level of complaints could be underestimated. Smith et al (1981) make the observation that their own study was probably influenced

by the general climate of the organisation at the time of the survey due to the study sites not being selected randomly from within the companies, but "were known sources of union complaints about health problems", and therefore the study had "limited generalizability".

3.5.3 There are many of the studies which lack the use of a comparison group or information on the variation in the amount of time spent on the VDT (Brown et al 1982, Rinalducci et al 1983, Howarth and Istance 1985, Kahn and Cooper 1986). There is a tendency in the studies to dichotomise work as either with or without a VDT, and not to consider VDT work as a continuum of exposure to interaction with the machine. The detailed tasks of the jobs are not described and there is an assumption that jobs with similar titles, where some use a VDT and others use traditional work methods, are satisfactory for comparison purposes without detailed task analysis to check on the areas of similarity (Christie 1985, Kahn and Cooper 1986, Grandjean 1987). The majority of job titles used by researchers will generalise what is frequently workplace unique tasks and there could well be
important differences that produce different responses in otherwise similar types of work.

3.5.4 In addition, there is frequently no satisfactory description of the type of VDT use and generalised categorisation, eg data entry or retrieval, loses the possibility of valuable distinctions (Brown et al 1982, Rinalducci et al 1983). It has been suggested that a good taxonomy of VDT activities needs to be developed (Landy et

al 1987) which integrates the time and nature of the activity at the VDT (Staehle et al 1984).

3.5.5 Finally, many of the self report measures used in the field surveys have unknown or unreported levels of reliability and validity (Rinalducci et al 1983), due in part to many of the measures being readily available or developed to save space on the questionnaire, rather than the main concern being their reliability and validity (Brown et al 1982).

3.5.6 Despite the shortcomings of the field surveys it would be impractical to expect all the ideal criteria to be met and not least of these difficulties is gaining entry into organisations to carry out surveys unless management can see potential benefits from the knowledge gained and the employees and their representatives, if the organisation is unionised, agree to engage in the exercise. The practical constraints that the management place on the researcher does mean that some of the best practice guidelines cannot be implemented, and Christie (1985) goes as far as saying that "access to workers is typically brief, selective and grudgingly provided".

4. THE PRESENT STUDY

Chapter Summary

The approach and the model underlying the present study is explained. The questionnaire, developed as the major source of data collection, and the measures used are described. This is followed by the outline of the measurement protocol and how the ergonomic features of the VDTs and workstations were assessed.

4.1 THE BASIS OF THE CURRENT ENQUIRY

4.1.1 During the past decade offices have been the scene of new technological innovations the most significant of which has been the introduction of visual display units, whether as part of a micro-processor or linked to a larger machines, mini or mainframe. These changes have been as dramatic in the offices of central government as anywhere else. Major change, which is what has been happening in the large "clerical factories" and the local office networks of government departments, are traumatic events at the best of times. The design and implementation of these new systems has often been left to the systems experts with a prescribed central imperative "to get it in and get it working".

4.1.2 However, if the management of these changes is to make the maximum impact on the efficiency and effectiveness with which the work is done it was seen as extremely important by the team I was working for at the commencement of this study - the Cabinet Office Job Satisfaction Team - that they become part of a much wider process. Issues such as job design, work procedures, organisational structure,

management styles, communications and training all need to be developed together. There was considerable experience in the Job Satisfaction Team of working with major change (Hodgson 1985, Shaw 1985) but there was a need to develop a greater understanding of what was happening with regard to job design issues related to the use of VDTs in government offices. In addition it was considered that there would be merit in using the knowledge gained to update and improve existing internal literature giving guidance to managers and computer specialists who were grappling with unfamiliar areas of work.

4.1.3 The impact of the new technology affects the jobs, the work environment, and the psychosocial systems. It was seen as necessary at an early stage of the research, to develop an integrated model in order to address the questions relating the changes in job content and job design with the outcomes of job satisfaction and the users' personal well-being. The more recent applications of information technology were being used by managers more than hitherto, so it was also seen as important to differentiate between the clerical and management users. There was at that time a paucity of published scientific work on the effects of IT on the jobs of managers (Hedge and Crawley 1982).

4.1.4 At the inception of the study I had not found any reported research in this area using a two stage methodology, that is measuring the variables both before and after the computer system had been implemented and "gone live", though a few had been reported (De Groot and Kamphius 1983, Hedman and Briem 1984), and since that time a further small number (Wright 1987, Westlander 1987, Linstrom and

Leino 1989). This approach was advocated by many critics of the previous research as an improved methodology to obtain data which can be considered more appropriate for causal analysis (Rinalducci et al 1983, Ivancevich et al 1983, Howarth and Istance 1985, Kahn and Cooper 1986, Landy et al 1987).

4.1.5 In order to examine different job profiles and also havea clearer differentiation between the types of VDT use and the working time at the VDT the four sites surveyed generally fit into the VDT activity-time matrix suggested by Staehle et al (1984). They define their VDT activity typology into four main categories which are related to the categories applied by previous researchers eg Cakir et al 1980, and placed on the matrix according to the daily working time. The matrix is shown at figure 4.1.

4.1.6 The types of VDT activity are as follows:-

- Data acquisition - data input with visual check I - high usage, II - low usage;
- Data recall - III - recall of the stored information by one or more user's
- Dialogue I - IV - data input and recall with checking and amendment facilities;
- Dialogue II - "interactive working" such as interactive programming. V - high usage, VI - low usage;

The activity types have to be regarded as being on the time continuum and there could well be different people within the same job in the one organisation who would be at different positions on the time axis. This would be particularly true of people working with very flexible software packages such as office support systems, ie, integrated word processing, database, spreadsheet and

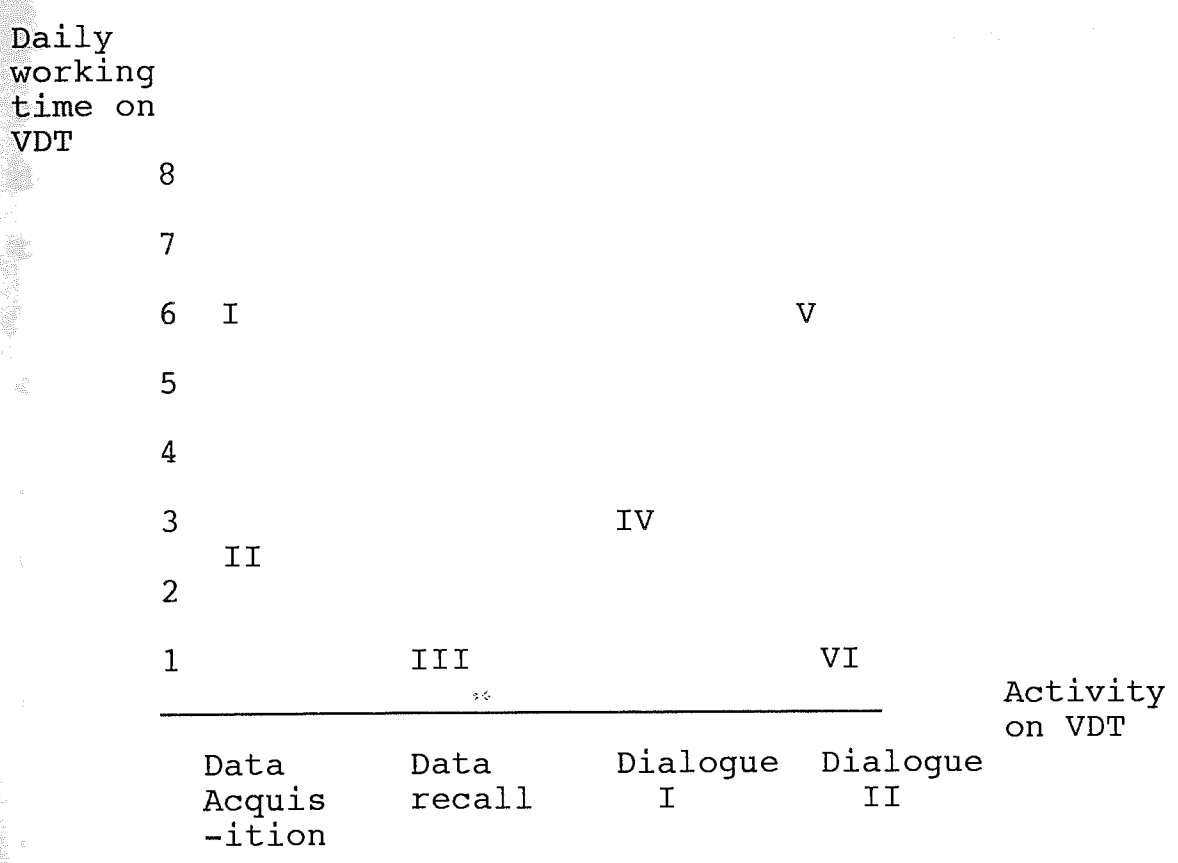


Figure 4.1 VDT activity-time matrix (Staehle et al 1984)

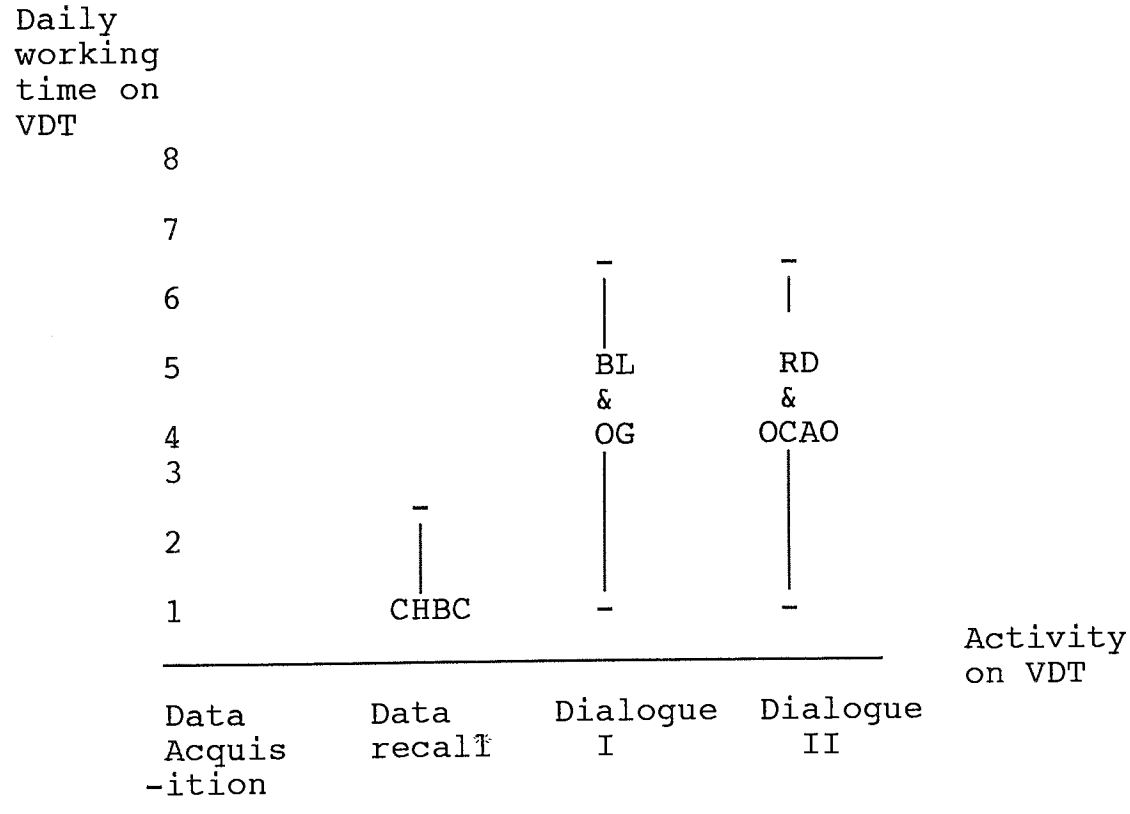


Figure 4.2 VDT activity-time matrix (Staehle et al 1984) with the study sites.

NB - BL-British Library, CHBC-Child Benefit Centre, OCAO-Office of Chief Adjudicating Officer, OG-Overseas Group, RD-Regional Directorate.

communication software. The users surveyed in this study are shown on the matrix in figure 4.2 and the detailed description of the VDT activities for each site are given in the relevant results chapter (see chapters 6 - 10).

4.2 THE DEVELOPMENT OF A MODEL

4.2.1 The office environment and the behaviour of people within it is a complex set of phenomena. The complexity encountered in this "apparently chaotic world is best understood as a complex of inter-acting systems" (Checkland 1972). A system can be defined as "a grouping of parts viewed as a whole, such that because of the inter-relation of the parts, the group has overall properties which are not apparent from the individual parts" (Open University 1974.)

4.2.2 The models referred to in Section 1.2 (1.2.14 - 1.2.20), as with the generality of models, are designed to reduce the multiplicity of phenomena to aid understanding of the relationships that exist between the elements of the model. The key elements which this study wishes to examine are found in the thinking and the proposed model of Ivancevich, Napier and Wetherbe (1983.) They viewed stress as an intervening variable with antecedent causes and ensuing consequences (figure 4.2.1.). This approach is also consistent with Cooper's (1986) model which he espouses as an aid to understanding the complexity of organisational sources of stress.

4.2.3 Drawing on this conceptual framework my model (figure 4.2.2) integrates two important aspects of work

stressors, the office environment and the content and characteristics of the work tasks. Briefly the model presumes the characteristics of the employee leads to different perceptions of the job content and the office environment, which then leads to affective states of job satisfaction and participation in decision making. These variables in turn influence the level of stress and subsequently the outcomes of ill-health. This model is applied to the situation found prior to the introduction of visual display terminals.

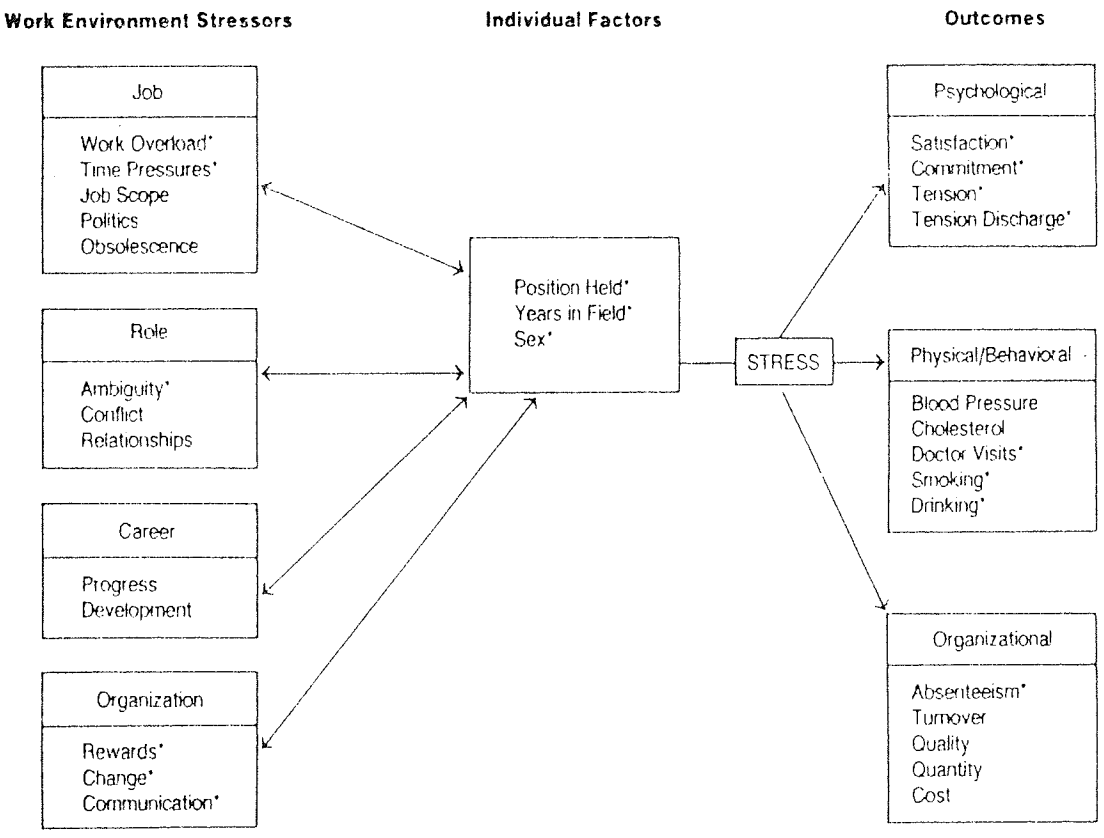


Figure 4.2.1 Model of Organisational Stress. (Ivancevich, Napier, Wetherbe, 1983)

Figure 4.2.2 Proposed Interactive Model for Office Workers Responses to the Job and Office Environment Prior To The Use of VDTs

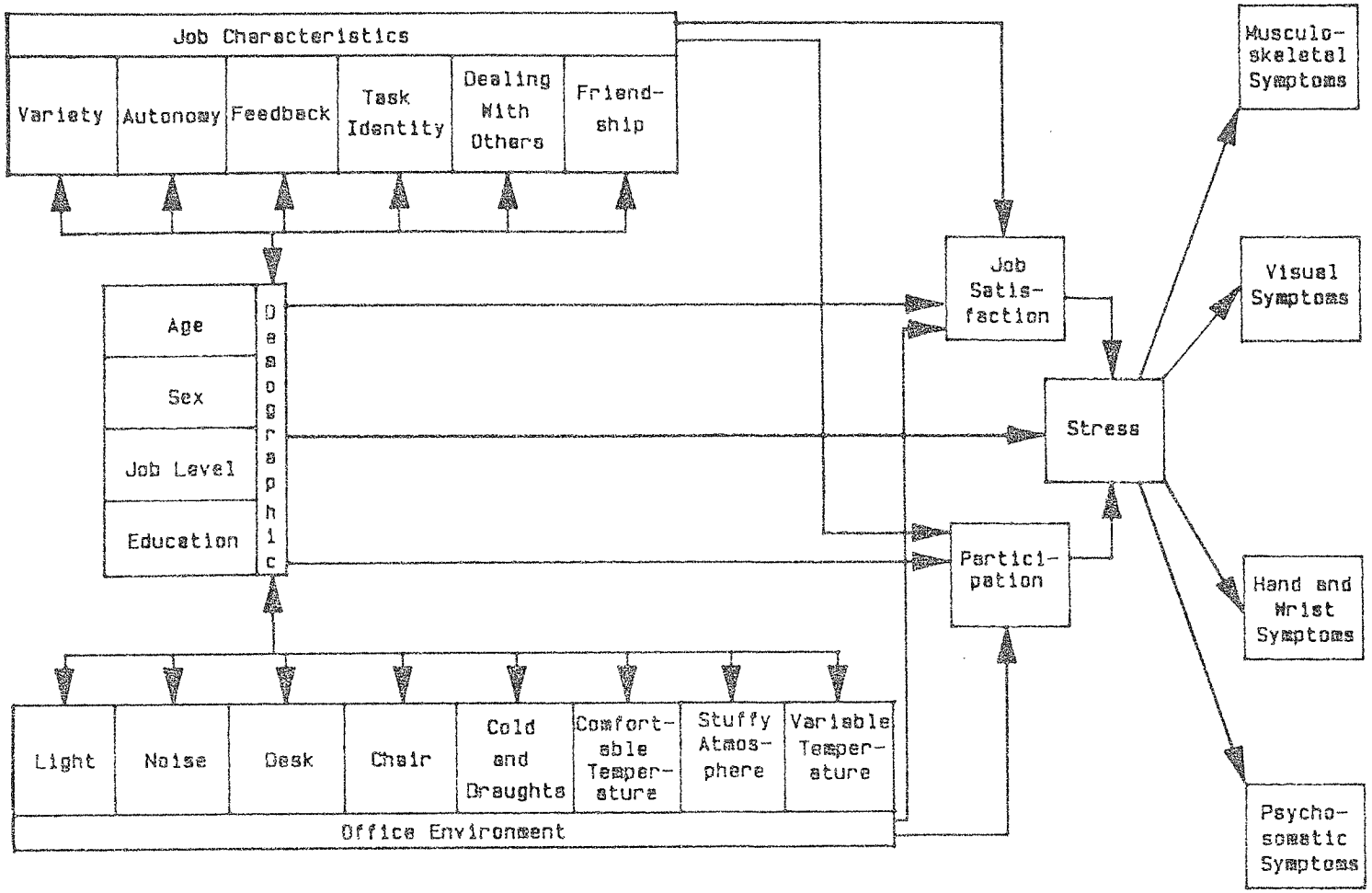
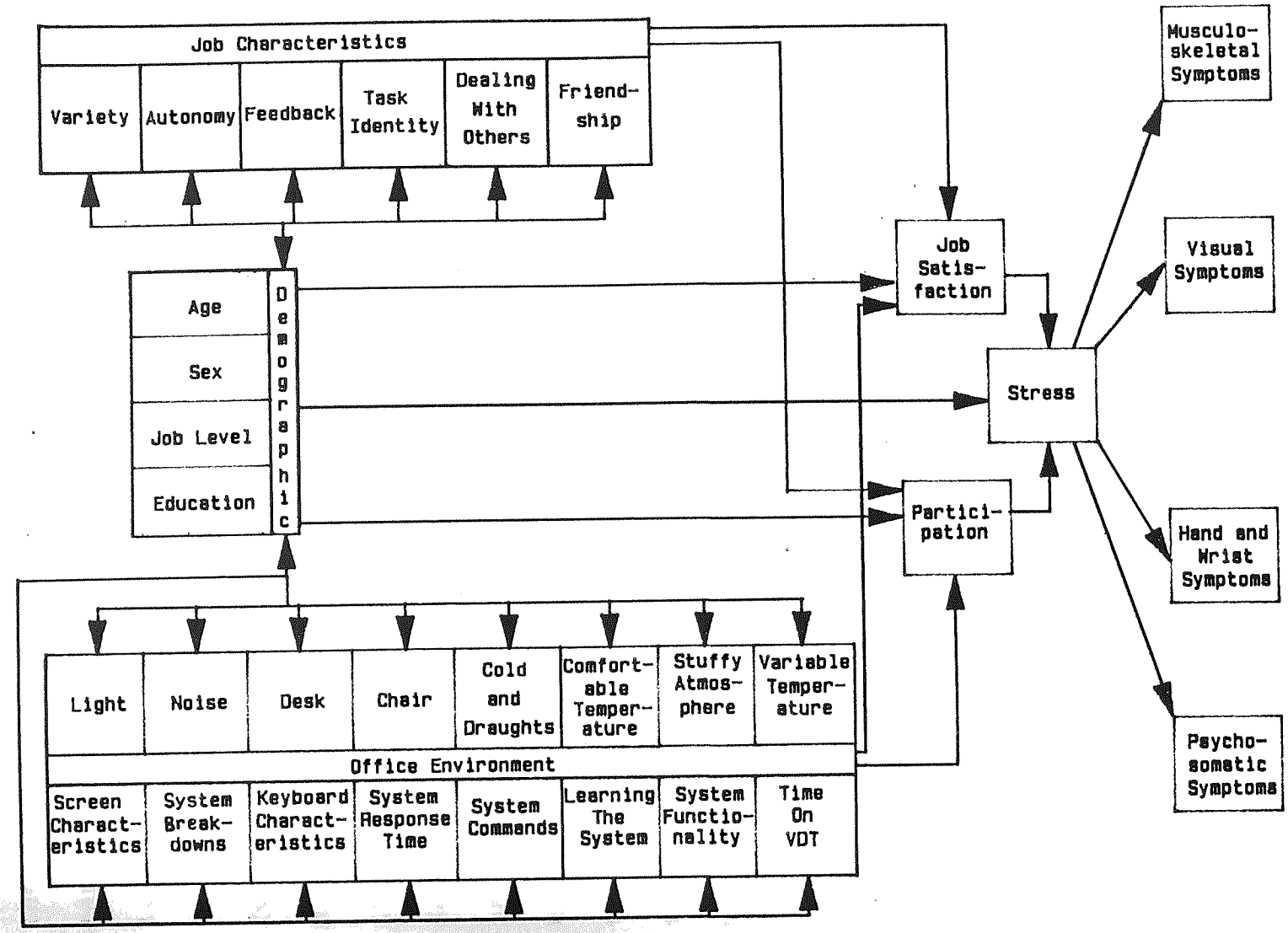


Figure 4.2.3 Proposed Interactive Model for Office Workers Responses to the Job and Office Environment Following the Introduction of VDTs



4.2.4 The post-implementation model (Figure 4.2.3) is an amended version of the original model having the addition of characteristics of the VDT workstation and computer system performance as part of the office environment which impact themselves on the worker. The model integrates the concept of man/machine relationship seen in Oborne's model (Paragraph 1.2.14) and Turner and Karasek's tripartite model (Paragraph 1.2.18) with that of the organisation stress model of Ivancevich et al (1983) and Cooper (1986). Even though the models of Ivancevich et al (1983) and Cooper (1986) have influenced the author's model, the final proposed model departs from their models. The two variables of job satisfaction and participation are regarded as outcomes in their models but in the revised model that is being proposed the level of job satisfaction and participation perceived by the office worker mediates the level of stress felt by them. The relationships and links in the model are explained in the following sections.

Individual characteristics

4.2.5 Individual characteristics have been found to be correlates of several variables including job satisfaction and stress. Age is a variable that is associated with an interrelated group of effects that influences work attitudes and behaviour. Whilst psychosocial and behavioural ageing describe the changes in work values, needs, and outlooks as the person grows older. Differences between older and younger employees are the result of different amounts and kinds of work experience (Pond and Geyer 1987) eg older workers often have more scope for controlling their work situation because

of tenure in the organisation and the likely higher position (Hulin et al 1985; Seashore 1974). Other influences on job satisfaction associated with age are the effects of education and common life experiences. Glenn and Weaver (1982) found that variation in job satisfaction attributed to age differences is primarily due to generational differences in work values and perceptions of the work itself. Studies have found conflicting and thereby inconclusive results in the examination of gender effects on job satisfaction (Neil and Snizek 1988). Women frequently hold less skilled, less interesting and lower status jobs. Neil and Snizek (1988) suggest the observed differences attributed to gender are instead a function of hierarchical position. They found that there was no evidence for gender being a moderating effect on job satisfaction and that it is probably due to a lack of systematic controls in the studies.

4.2.6 Many individual characteristics might be correlates of stress. Beehr and Newman (1978) in a meta-analysis list 31 variables in four sub-sections which contributes to a "personal facet" in a facet modelling of stress. Four of the six variables in the demographics sub-section are age, sex, education and occupation, these are used in the model in this study. Motowidlo et al (1986) refer to several studies that have found negative relationships between age or experience and occupational stress. They suggest that this could be explained by either selective withdrawal, the people who remain with the organisation longer are those with the more stress-resistant traits; or adaptation, people eventually develop coping mechanisms to deal with stress and because

this takes time the more senior job holders will be more fully adapted, and should experience less stress.

4.2.7 The relationships found between job characteristics and individual characteristics has been examined in a few studies. Fried and Ferris (1986) found that both age and education and position within the organisation influenced the job incumbents perception of their job characteristics. Katz (1978a) found that organisational and job longevity influenced the relationship between task dimensions and overall job satisfaction. The hierarchical nature of the civil service and the related promotion systems produce a situation whereby the more senior grades and job incumbents are generally the longer serving, so the job level variable will probably have similar effects upon the intermediary variables in the model.

Work Environment

4.2.8 Many work environmental variables have been studied in stress research. Beehr and Newman (1978) suggest four main groups of variables which could be examined; job demands and task characteristics, role demands, organisational characteristics, and organisation's external demands and conditions. The focus of interest from this wide range of possible variables are task characteristics and a variable to gauge an important attribute of the organisational climate, ie participation. Miller and Monge (1986) found, in a meta-analysis into participation, satisfaction and productivity, that participation has an effect on job satisfaction and productivity, though somewhat stronger on satisfaction. A further important reason for the inclusion of participation

as a variable is the finding that the most successful technological changes have come about when the "real" end users have been involved in the whole cycle of change (eg Mumford 1980, Eason 1983, Matherly and Matherly 1985, Thompson 1989.)

4.2.9 The job characteristics model of Hackman and Oldham (1975) suggested that there are links between the dimensions of the model and job satisfaction. Positive relationships have been found by among others, Brief and Aldag (1975), Stone (1976), Loher et al (1985), Glick et al (1986). The meta-analysis of Loher et al (1985) of 28 studies found a correlation between the job characteristics and job satisfaction measures of "about .39". The relationship between each of the task characteristics and job satisfaction ranged from .32 (task identity) to .46 (autonomy). The two-factor job satisfaction theory of Herzberg et al (1959) suggests that the job characteristics model would be motivating factors whereas the office environmental conditions are hygiene factors; both groups of variables will therefore influence job satisfaction.

4.2.10 Studies into the office worker's views about their working environment have found a range of responses to what is seen as a comfortable environment. Room temperatures, draughts, excessive heat, noise, are found to be sources of dissatisfaction (eg, Stammerjohn 1981, Dainoff 1982, Hedge 1982, Wineman 1986, Sundstrom 1986). There has also been found to be a difference in the attitude of the worker to the different environments created by open plan and cellular offices (Hedge 1982, Hedge et al 1985, Hedge et al 1987).

These differences between what the worker requires to feel comfortable, in order to do a satisfactory and effective job, and what the office environment provides may contribute to the levels of stress (Hedge et al 1986).

4.2.11 Research has also been conducted at a different level into the physical aspects of the office environment. Workstation design and VDT ergonomics have played an important part in the research into the impact new technology has had upon the office worker (eg Cakir et al 1979, Boyce 1981a, Stammerjohn et al 1981, Bradley 1983, Brunner et al 1985). Because of those findings and the main focus of this study being concerned with the impact of the VDT on the user, the post-implementation model (figure 4.2.3),integrates factors of the workstation design and computer system performance into the broader office worker model.

4.2.12 The focus of previous studies has moved from physical problems associated with VDT work in the earlier research, to the computer system performance and job design issues in more recent studies. An important issue still centres upon the health outcomes from the model and the amount of variance contributed by the different major groups of antecedent variables.

4.2.13 The model assumes that if the antecedent variables to the outcomes of stress and the health symptoms are changed, by the introduction of a new piece of technology, or a change in the work procedures, then this will have some influence upon the stress and health outcomes. The model is therefore to assist in examing the relationships between the individual

characteristics, work environment (job characteristics, office environment, work station design, computer system performance), affect (job satisfaction, participation), the stress and health symptoms.

4.3 THE QUESTIONNAIRE DESIGN

4.3.1 The method of data collection for the survey was by a self-completed question. The initial section (Appendix 1b) was a series of questions asking about the respondents biographical details. This section and the subsequent four sections dealing with the office environment, the person's wellbeing, the job characteristics inventory and job satisfaction measure were completed before and after the installation of the VDTs. Section 5 of the Stage 2 questionnaire was completed only at that stage to ascertain information and views about the VDT and its use (Appendix 1c).

Office Environmental Conditions

4.3.2 This section of the questionnaire (1) dealt with the office climate, both winter and summer temperature and ventilation. Comfort ratings about the lighting, noise factors and the furniture (desk and chair) completed this section. The questions had previously been used in a large survey (4373 subjects) examining the impact of different ventilation systems in buildings (Burge et al 1987). The original format used a 7 point Likert scale which was reduced to 5 points for the current survey.

4.3.3 A test re-test reliability assessment of the questionnaire was carried out on six buildings at 1-2 yr interval and a close correlation found between the two surveys (r=0.96) (Burge et al 1987). The results of that survey successfully differentiated between different buildings in the survey. There are 16 items on the ambient conditions, 5 items on the light attributes, 4 items on noise and one each on the user's desk and chair.

Personal Well-Being

4.3.4 There are two questions in Section 2.
Question 1: The items in question 1 are symptoms of ill-health and stress felt by people at work. These items are drawn from three previous studies which examined the effect of VDUs, or more general office work, on the employee's health. Sauter et al (1983) used an inventory of 59 items of diverse medical symptoms experienced within the year prior to the completion of their questionnaire. Dreyer et al (1981) did not use as large an inventory in their studies of office workers in Europe, and Burge et al (1987) used 10 items for the health symptoms inventory with a 4 point Likert scale.

4.3.5 The 18 items of the inventory at Question 1 were taken from the items with the most frequent response rate in the studies mentioned and a five point Likert scale applied ("never" (1) to "always" (5)). A test re-test reliability assessment of the health symptom inventory was carried out by Burge et al (1987) who found that there was a high level of consistency among a small sample of office workers over a two week period, although they did not report the reliability coefficient.

4.3.6 Question 2: The measure used for examination of the wellbeing at Question 2, Section 2, was the General Health Questionnaire. This is a self-administered screening test developed by Goldberg (1972) in order that two phenomena could be examined:

1) the inability of the respondent to carry out normal healthy functions,
2) detect the appearance of new phenomena in the individual of a distressing nature.

It was intended to serve as a screening instrument and to identify potential cases of mental ill-health so that actual cases could be diagnosed by psychiatric interview" (Goldberg 1972).

4.3.7 The questionnaire was developed to gain the advantages of a self-administered instrument:-

a) large number of subjects can be approached,
b) it is cheaper and less time consuming than an interview procedure by professional personnel,
c) it eliminates the problem of varying standards between different interviewers,
d) scoring is an objective procedure as the scorer does not have to make subjective judgements.

4.3.8 The focus of the questions is such that prominence is given to symptoms and not to personality traits. The design aimed to avoid several weaknesses of this genre of questionnaire:-

a) the reliability of the respondent with regard to their description of the symptoms of illness may not correspond with clinician's impressions at an

interview,

b) respondents can be reluctant to reveal their minor experiences to other people. This "defensiveness" would manifest itself for instance where a respondent would not divulge having symptoms described in the questionnaire, although it is known to others that they suffer from symptoms.

c) the tendency for any given individual to agree or disagree with propositions put to them, irrespective of the content of the statements. In order to reduce "overall agreement set", in a health questionnaire, items are arranged so that in half of them agreement signals illness, whereas in the other half agreement indicates health. However, because of the content and social desirability of items it cannot be insured that an overall agreement set will cancel itself out. It does allow, though, for an overall agreement set to be assessed independantly of content, so that they can be measured if not fully eradicated.

d) many mental health questionnaires include a "lie scale" in order to assess the level of which the subject is influenced by the "social desirability" of the response to the questions. Goldberg (1972) however concedes that this tendency is difficult to eliminate.

4.3.9 The questionnaire was designed to exclude any items which indicated a personality trait and all items had to be

applicable to the whole population. After exclusion of items under these criteria and applying principle components analysis a 60-item questionnaire was trialed.

4.3.10 In order that a shorter version of the questionnaire should be available a selection of items was obtained, following the satisfactory reliability and validity studies. Pilot studies were carried out in a general medical practise setting and a medical out- patients department (Goldberg 1972). As the questionnaire is reduced in length it is less likely to be refused by subjects for completion. The reliability and validity coefficients show progessive reduction in a 36, 30, 20 and eventually 12 item version. Goldberg (1972) considers that even for the 12 item version the coefficients remain at an acceptable level: test-retest reliability coefficient 0.73, split-half reliability 0.83, validity coefficient against the general medical practitioner assessment of 0.77.

4.3.11 Because the measure identifies symptoms of minor depressions and anxiety states, Goldberg (1972) regards the questionnaire as being able to meet a number of requirements, two of which are relevant to this research:

a) the metal ill-health score on the questionnaire can be correlated with other variables of a given population,

b) a given population can be tested on different occasions in order to follow the changes that occur in subjects over time.

4.3.12 Because it was considered that there was not a suitable short and valid measure of mental health for use

with work populations, a research study examined the GHQ for its psychometric adequancy within occupational settings (Banks et al 1980). Banks et al (1980) considered that the 12 item version of the GHQ was most relevant to occupational application because of it being used as a measure of one of a number of variables. The longer versions would be ruled out by time considerations as part of a multi-instrument questionnaire. The occupational validation study also examined the Likert method of scoring compared to the bimodal method of scoring that Goldberg (1972) developed. He was only concerned with establishing correct classification into two groups; those with ill-health symptoms and those without. Banks et al (1980) however wished to have the richer information of a multi-point Likert type scale. It was found that using three occupational groups - employees in an engineering plant, recent school leavers, unemployed men - that the Cronbach alpha coefficient, indicating internal consistency,remained high across the three samples; between 0.82 and 0.90. The unemployed sample was the only one to have any difference between the two scoring methods; in which instance the Likert method produced higher item-whole correlations.

4.3.13 Banks et al (1980) found that the GHQ12 was not sensitive to age, job level, or marital status differences in the sample. They did not find that it differentiated between the sexes and employment status, which was considered as lending some construct validity for the scale. Wall and Clegg (1981) in a study of job re-design had found that the GHQ12 score, as a dependent variable, had changed substantially and beneficially as well as having

statistically significant results ($p<0.001$). They concluded that their study suggests that the effects on mental health of job redesign programmes are relatively slow to occur but are clearly observable using GHQ12. Stafford et al (1980) used the GHQ12 as a measure of psychological well-being among 647 recent school leavers. The regresssion analysis indicated strong evidence for employment status and a measure of work investment acting jointly on psychological well-being. The unemployed, young women, and subjects in social classes 4 and 5 had higher GHQ12 scores.

4.3.14 As a measure of psychological well-being the GHQ12 appears suitable to use where a short measure is required; a measure that can differentiate between conditions over time, and can detect changes in the mental well-being of subjects following changes in the features of the respondents jobs. Throughout the Results and Discussion sections of this report the measure (GHQ12) is referred to as the "stress" measure.

The Job Characteristics Inventory

4.3.15 The characteristics of a job can be ascertained broadly in two different ways:- the objective assessment by a third party and the perceptual measurement technique involving the job holder in expressing their perception of the characteristics of the job.

4.3.16 The perceptual measurement of job characteristics was developed among others by Turner and Lawrence (1965) and later by Hackman and Oldham (1975). Both sources used a set of six core job dimensions - autonomy, variety, task identity, feedback, working with others, and friendship

opportunities. The first four dimensions were regarded as the "core dimensions" and the latter two were included to examine the relationship of interpersonal relationships with job design. These latter two dimensions were not considered to be central to the level of job satisfaction.

4.3.17 The Job Characteristics Inventory (JCI) of Sims, Szilagyi and Keller (1976) was developed in order that a reliable and valid instrument was available to examine how the individuals perceive their jobs. Even though the emphasis is upon the job holder's perceptions it is important that a perceptual measure has a satisfactory degree of correspondence to the objective attributes of the job."It must have the power to discriminate between different jobs" (Sims et al 1976), particularly if the instrument is to be used to explore the relationship between job characteristics and the job satisfaction of the individual.

4.3.18 Sims et al (1976) developed th JCI using two organisations: the staff of a large hospital and a manufacturing firm. The range of staff from both organisations was quite diverse:

1) the hospital - nurses, occupational and physical therapists, administrative, technical and clerical staff,
2) the manufacturing firm - directors, group managers, engineers, and line foreman.

A total of 1161 questionnaires were obtained from the hospital personnel (79.6% were female) and 192 questionnaries from the manufacturing firm (they do not report the percentage of female respondents). The instrument was

originally administered at the hospital. Subsequent to analysis, and the addition of some revised items, it was administered to the manufacturing firm's employees. A variety of techniques were used to examine the construct validity, convergent and discriminant validity, and reliability of the JCI.

4.3.19 The reliability coefficients for all the dimensions of the JCI, with the exception of dealing with others dimension, were above 0.75:- variety - 0.78, autonomy - 0.84, feedback - 0.83, task identity - 0.75, dealing with others - 0.68, friendship - 0.84.

4.3.20 The four "core" dimensions demonstrated convergent and discriminant validity, with the validity coefficients being significant at the .001 level. A further study by some of these authors, reported in the original paper, found congruency coefficients in the upper .80s and .90s on all the six dimensions.

4.3.21 At the time of the development of the JCI, Hackman and Oldham (1975) had developed a similar instrument (the Job Diagnostic Survey) which was the more widely used of the two. Because of the parallel development and some criticism of the JDS, on the grounds of the empirical dimensionality varying across samples (Dunham, Aldag and Brief 1977). Pierce and Dunham (1978) compared the dimensionality and the internal consistency of the JDS and JCI. The focus of their work was the four core dimensions (variety, autonomy, task identity and feedback) which are common constructs to both instruments. The questionnaire containing both instruments was administered to 155 employees (75 females and 82 males)

of an insurance company. The reliability coefficients were above 0.85 for the four JCI dimensions whilst the JDS scales ranged from 0.69 (feedback) to 0.79 (autonomy). Inter-correlations between the JCI and JDS scales indicated adequate convergent validity for each of the four dimensions (r=0.65-0.74). A factor analysis, by four-factor oblique rotation, confirmed the core dimensions of the JCI but failed to do so for the JDS. Pierce and Dunham (1978) concluded that the dimensional fluctuations of the JDS across samples could be due to the measurement process, and not to the underlying dimensionality of job design characteristics. The JCI was used in its entirety in Section 3 of the questionnaire in this study.

Participation in Decision-Making

4.3.22 White and Ruh (1973) developed a short scale, as part of a larger measure, in order to investigate the moderating effects of individual values on the relationship between participation in decision making and attitudes towards the job. They used a sample of 2,755 manufacturing employees, 51% were males and 49% were females, from the mid-west of the USA.

4.3.23 An internal consistency of 0.81 is reported with correlations of 0.53, 0.38 and 0.47 between their participation scale and job involvement, motivation, and job identification measures indicating a reasonable level of validity. A sub-analysis, which produced respective correlations for blue collar workers and managers between participation and job involvement of 0.44 and 0.53,

strengthens this view. The mean and standard deviation for the total sample was 3.0 and 0.86 respectively.

4.3.24 The participation items were randomly assigned to points among the questions in the JCI scale in this study's questionnaire and not left to stand alone as a separate measure.

Job Satisfaction

4.3.25 The measure selected for evaluation of job satisfaction is one of many measures designed for this purpose. The Brayfield and Rothe (1951) "Index of Job Satisfaction" is multiple-item measure of overall job satisfaction. It obtains reactions to eighteen items of a general nature, all being variants of a central theme of how much the respondent likes their job. Because the instrument for examining the subjects perceptions of their job, the Job Characteristics Inventory (Sims, Szilagyi and Keller, 1976), deals with views of the job dimensions, it was considered inappropriate to use a measure which assessed specific satisfactions in the job. In addition, a short measure, was required - completion takes approximately 4 minutes.

4.3.26 The scale was designed to meet several criteria:

a) it should be applicable to a wide variety of jobs,

b) it would be sensitive to variations in attitude,

c) it should yield a reliable and valid index,

d) it should be brief and easily scored (Brayfield and Rothe 1951).

4.3.27 The scale was designed for use in the United States Army, and the Thurstone Scaling technique was used in its

development. Reliability was found by the authors to be 0.87 for internal consistency corrected by the Spearman Brown formula using a group (231) of female office employees.

4.3.28 Validity was tested by the authors using two groups from a night school class. The class members with expressed interest in the subject of the class and with jobs appropriate to the subject, scored more highly than subjects whose jobs were inappropriate to their expressed interest in the class subject. The authors also correlated scores on the Hoppock Blank - a job satisfaction questionnaire used widely in the 1930s - obtaining a product-moment correlation on 0.92 ($p<.01$). An independant study correlated scores with the Job Descriptive Index (Smith Kendal and Hulin 1969) obtaining a median correlation of 0.66 (Evans 1969). A truncated version of the scale was used by Cooper and Cox (1985) when examining the level of dissatisfaction among a sample of 24 word-processing operators working in a number of service-based organisations (eg. banking, insurance). The measure successfully distinguished between the WP operators and a control group of copy typist secretaries. The Job Satisfaction measure is Section 4 of this survey's questionnaire.

Work with the VDT

4.3.29 In Section 5 the questions relating to the use of the VDT were set. This section was only used in the post-implementation questionnaires. Question 1 to 4 were concerned with the amount of time spent on the VDT and the type of work it was used for. Question 5 and 6 were inventories concerned with the VDT characteristics, the systems performance, and

the interactive factors for the users of working with the system. The final question was concerned with any previous experience the user may have had with VDTs at home, or in their education.

Piloting of the Questionnaire

4.3.30 Despite the majority of the measures in the questionnaire being thoroughly documented and used in research reported in the professional journals, there were parts of the questionnaire which had not been used in the particular format proposed for this study. It was therefore considered appropriate to pre-test the whole questionnaire. The main objective of the pre-testing was to discover any ambiguities and to time the completion process.

4.3.31 Ten VDT users at the British Library Document Supply Centre assisted in this process. The questionniares were distributed during working hours to the group of volunteers who had assembled in a quiet meeting room. The purpose of the exercise was explained by the researcher, the questionnaire was then completed and a detailed discussion took place to obtain comment and suggestions on the design layout and wording of questions.

4.3.32 The questionnaire administered to the pilot group is shown at Appendix 1a. The group completed the questionnaire between 22 and 29 minutes. The comments and suggestions resulted in a number of changes, the most significant being the omission of question 2 in Section 3 and the use of a uniform method of assigning the choice of response; they favoured writing a number in the blank next to the statement

rather than circling a number on scale description. They also suggested that "headaches" should be added to the health symptom inventory (Section 2(1)).

4.4 MEASUREMENT PROTOCOL

4.4.1 The self-completed questionnaires in all instances, were issued to participants at their workplace. The protocol, which was agreed with the management and trade union representatives at each site, was designed to ensure, as far as possible anonymity of the participants.

4.4.2 Because the research design had before and after measures, it was considered important that the subjects who had completed a questionnaire prior to implementation, should also complete a questionnaire twelve months after the "go-live" date. In order to achieve the dual aim of anonymity and a measure on two occasions from the same subjects, the person who distributed the questionnaires kept a list of subject's names and allocated a number to each person at the time of the first stage of completion (Stage 1). The form was completed during working hours, time being allowed by management for this, and returned by the subject by post direct to the researcher. The questionnaires issued at the second stage of data collection (Stage 2) was issued to all users including those subjects completing a questionnaire at the first stage, who could be identified by their number. The researcher did not have any access to the list of names held by the third party. Completion of the questionnaires was completely voluntary at both pre and post-implementation stages.

4.4.3 At each site, senior management and the trade union representatives had been briefed as to the purpose of the research. The subjects were then briefed about the research study and the questionnaire completion routine by either the management information cascade system (Sites 1, 2 and 4) or the Information Technology User Group members (Site 3). In all instances the questionnaire was issued with a letter (Appendix 2) from the researcher and pre-addressed envelope for return to him.

4.4.4 Due to circumstances surrounding the implementation of the information technology (eg management and trade union disagreement on items relevant to the implementation strategy, the timing of the researcher's introduction to the site, delay in the implementation date in the case of Overseas Group (OG), it was not possible to issue the questionnaires at a uniform period prior to the implementation date (Stage 1). The point in time of issue at Stage 1 was as follows:-

Site 1 One week prior to "go-live"

Site 2 sixteen months before the "go-live"

Site 3 nine weeks prior to "go-live"

Site 4 two weeks prior to "go-live".

This variation allows some of the subjects, particularly at Sites 1 and 4 to have undergone some "IT Awareness" training prior to completion at that Stage.

4.4.5 The administration of the questionnaire at Stage 2 was aimed at a uniform point in time, ie, twelve months after the "go-live date, though in practice the date of Stage 2 completion for three sites was approximately 11 months. The

questionnaire at Stage 2 was issued by the same person and accompanied with a further letter from the researcher (Appendix 2). The questionnaires were returned to the researcher direct by post.

4.4.6 Due to the "go-live" date being considerably delayed at OG (Site 2) the questionnaires were issued only 3 months after live running. There was therefore a longer period between the two stages of questionnaire adiministration at this site but closer to the "go-live" date.

4.4.7 Table 4.1 shows the dates when the questionnaires were issued, the number returned and the response rates. Comparatively speaking, the CHBC response rate at Stage 1 was relatively poor compared to the number returned at the other sites. The comparison however with some of the field studies in this area of research is quite satisfactory, eg Smith et al (1981) 50%, Johansson and Aronsson (1980) 74%, and many not reporting the response rate (Rinalducci et al 1983).

4.4.8 The gender and age data were obtained for the total populations at the four DSS sites in respect of the position as it stood on 1 April 1988. Table 4.2 sets out the age distribution data for both the total population and the sample of respondents who completed the questionnaires at both stages of the survey. A chi-square test found only the differences in the ages of the respondents at CHBC statistically significant from the total population at the site. None of the other sites had statistically significant

Table 4.1 Comparison of the number of questionnaires issued and returned

Site	Date	No Issued	No Returned	No Useable	Response Rate %
		Pre-implementation			
CHBC	Oct.1986	124	68	68	54.8
OG	Nov.1986	205	164	164	80.0
OCAO	Oct.1986	39	34	34	87.2
RD	Feb.1987	111	76	76	68.4
BL	Apr.1987	44	40	40	90.9
		Post-implementation			
CHBC	Nov.1987	120	82	82	68.3
OG	May 1988	180	129	127	70.6 (27)
OCAO	Dec.1987	47	41	41	87.2 (8)
RD	Jan.1988	109	70	62	56.9 (14)
BL	May 1988	44	32	32	72.7

NB. Figures in parenthesis are non-VDT users.

differences on age or gender. Despite there being age differences at CHBC there was no gender differences.

4.4.9 The reliability coefficients (Cronbach's alpha coefficient) were computed for the scales on the questionnaire; the results are shown at Table 4.3. The job satisfaction measure alpha coefficient was the highest of those used with the JCI, Health Symptom Inventory and the GHQ12 having almost identical coefficients. The coefficients were stable between the two stages, this adds confidence to their reliability. However, this could not be said for the participation measure, which had a lower coefficient at Stage 2 and was at the lower level of acceptability on that

Table 4.2 The gender and age distribution of the staff at the DSS sites

Years	Total Population	CHBC Stage 1	Stage 2	Total Population	OG Stage 1	Stage 2	Total Population	OCAO Stage 1	Stage 2	Total Population	RD Stage 1	Stage 2
Age												
Under 20	72 (17.5)	18 (26.9)	24 (29.3)	4 (0.6)	2 (1.2)	1 (0.8)	-	-	-	4 (0.9)	-	-
20-29	228 (55.5)	43 (64.2)	50 (61.0)	330 (48.0)	88 (53.7)	63 (49.6)	13 (9.1)	3 (8.8)	3 (9.1)	101 (21.4)	20 (26.3)	17 (31.5)
30-39	48 (11.7)	4 (6.0)	6 (7.3)	227 (33.0)	46 (28.0)	42 (33.1)	42 (29.4)	14 (41.2)	12 (36.4)	191 (40.4)	34 (44.7)	24 (44.4)
40-49	29 (7.1)	1 (1.5)	1 (1.2)	80 (11.6)	16 (9.8)	18 (14.2)	54 (37.8)	6 (17.6)	10 (33.3)	138 (29.2)	15 (19.7)	12 (22.2)
50-59	26 (6.3)	1 (1.5)	1 (1.2)	33 (4.8)	11 (6.7)	3 (2.4)	31 (21.7)	10 (29.4)	6 (18.2)	36 (7.6)	5 (6.6)	-
Over 60	8 (2.0)	-	-	13 (1.9)	1 (0.6)	-	3 (2.1)	1 (2.9)	2 (6.1)	3 (0.6)	2 (2.6)	1 (1.9)
Total	411	68	82	687	164	127	143	34	33	473	76	54
Gender												
Female	312 (76.0)	54 (79.4)	61 (74.4)	495 (72.1)	106 (64.6)	89 (70.1)	55 (38.2)	18 (52.9)	15 (45.5)	197 (41.2)	35 (46.1)	22 (40.7)
Male	99 (24.0)	21 (20.6)	21 (25.6)	192 (27.9)	58 (35.4)	38 (29.9)	88 (61.8)	16 (47.1)	18 (54.5)	276 (58.4)	41 (53.9)	32 (59.3)

NB Percentages are in parenthesis

Table 4.3 Reliability coefficients for the survey population on the questionnaire scales

Scales	Pre-implementation Alpha-coefficient	Post-implemention Alpha-coefficient
Job satisfaction	.94	.92
Participation	.79	.69
Stress (GHQ12)	.86	.86
Health Symptom Inventory	.87	.87
Job characteristic Inventory	.87	.87
Office environment (Ambient conditions, lighting and noise)	.60	.78
VDT and computer system items	-	.66

occasion. The only occasion the VDT and Computer System items were used was at Stage 2 and the coefficient indicated that the reliability was not very satisfactory. The poorest level of confidence is clearly with the office environment measure which showed a similar low level of alpha coefficient at both stages of the survey.

4.5 ERGONOMICS OF THE WORKSTATION

4.5.1 Procurement of computer equipment and software at the study sites is influenced by directions and guidelines issued by the central civil service department,the Central Computer and Telecommunications Agency. These documents give detailed specifications and advice, which should be included in the tendering process, and also extends to giving information about the room environment and workstation design parameters. These documents are available to information technology

specialists and to the managers of user sites. From the information obtained from the personnel listed in paragraph 4.5.3 care was taken over the specifications in the tendering process in order to prevent, as far as possible, the potential VDT and workstation problems.

4.5.2 In addition to the questionnaire completion by the users at the four sites, an ergonomic checklist was completed in order to enquire into the VDT, workstation and office environment. The use of the checklist was regarded as the most efficient way of summarising the ergonomic detail relevant to VDT use at the four sites (O'Neill and Birnbaum 1984).

4.5.3 The checklist used was a selection of items from the checklists found in Cakir et al (1980) and that of O'Neill and Birnbaum (1984). The items selected from both checklists had to be applied independently of the use of special measuring equipment eg light meters, and also free of the need to seek user opinion which was being ascertained in the questionnaire. The balance of items relating to the screen and keyboard of the VDT workstation are from the checklist of Cakir et al (1980), whilst the room environment items are mainly from O'Neill and Birnbaum. The completed checklist for each site is at Appendix 4.

4.5.4 The checklist was completed for the four DSS sites with the co-operation and assistance of the following:-

CHBC - member of ADP section

OG - member of Office System Support Team

OCAO - Systems Manager

RD - Systems Manager

At each site a sample of the workstations in use was examined and where appropriate measurements taken.

4.5.5 The examination of the display images was limited by the absence of measuring equipment to ascertain the performance on several of the parameters that were frequently found to be wanting, such as the thickness of lines and luminance levels of the characters (eg Cakir et al 1980, Stewart 1980). However, the technology is improving all the time so one would expect the quality of the displayed image to improve, and within the limitation mentioned above, this was the position found in the examination. There were two of the parameters on the checklist which did not meet the requirements. Firstly, all the sites had VDTs that had no facility for repressing the cursor blink, and secondly, the character set at OCAO did not have three characters that many of the users required for the specialist work that they have; 1/2, 1/4, and -:- . This deficiency was probably due to an inadequate understanding of the detailed user requirements and therefore an omission in the tendering specification.

4.5.6 Manufacturers of the equipment seen at these sites had progressed in the design of their keyboards because all of them were detachable and had slim styling. They all used the Querty layout for the keyboard plus a separate numeric keypad. At OG there were three keyboard deficiencies and two at OCAO. The more serious problem occurred at OG and RD due to the absence of sufficient resting room for the palms of the hands adjacent to the keyboard and was more a problem of the inadequate space on the desk top rather than the keyboard being poorly designed.

4.5.7 All the users had gas-lift adjustable chairs which met the checklist requirements. The greatest effort had been made at CHBC and OCAO to provide adequate desk facilities with new desks having been purchased but none of the desks

Table 4.4 Summary of the Ergonomic Shortcomings

Deficiency	CHBC	OG	OCAO	RD
Cannot repress blinking of the cursor	X	X	X	X
Missing characters			X	
Angle of keyboard not in the range 5-15 degrees	X			
No 50mm deep space provided for resting palms		X		X
No audible keyboard signal	X			
No warning if keys pressed simultaneously	X			
Square key tops more than than 15mm across				X
Key legends not moulded into the keytop				X
No footrest provided		X	X	X
No document holder available	X			X
Depth of desk not between 650-750mm as a minimum				X
Leg area not 800mm wide and knee room restricted			X	X

were adjustable. The most frequent shortcoming with regard to the workstation provision was the absence of a footrest at all the sites except CHBC. The desk dimensions at RD were

the poorest due to a lack of adequate depth, which created space difficulties, and insufficient knee room. Two of the sites had no document holders provided. A summary of the findings is shown in Table 4.4

5 THE FINDINGS AND DATA ANALYSIS

Chapter Summary

The chapter outlines the way the data was analysed and the main research questions addressed.

5.1 Section 4.2 set out the model which underpins this study with the focus being on the interrelationships of the elements of the model and the changes which may have come about due to the introduction of working with VDTs. The objective is to add some clarification to the equivocal findings of other studies, many of which have cross-sectional designs, and the development of a greater understanding of the psycho-social issues relating to working with VDTs.

5.2 The study was designed on a quasi-experimental format of repeated measures, pretest and posttest, with the respondents acting as their own controls and a separate group of controls at two of the sites, OCAO and RD. In addition a fifth site was surveyed with VDT users completing the questionnaires at both stages of the study. This fifth site is a civil service organisation with the same organisational rules, procedures and a very similar culture to the main study sites. The purpose of using this site is to see if the measures used change in anyway over the same time span, with users who were not undergoing any major change during that period.

5.3 The survey data using the measures set out in section 4.3 has been initially analysed for each survey site. The background to the main work of the site, the office environment, the computer system and the training provided

for the users on the use of the VDT are described for each site in separate chapters. The descriptions are followed by data analysis for each site for the main measures of :-

1. Office environment
2. Job characteristics
3. Job satisfaction and participation
4. Health symptoms and stress
5. Working with the VDT

5.4 The statistical techniques used in these chapters involved frequency table analysis, univariate analysis of variance, and applying t-test and Mann-Whitney U tests to make comparisons between sub-groups and pre- and post-implementation measures. Comparisons on these measures are made within sites for differences in the data between the two stages of the survey to determine what changes have occurred on the main variables and to ascertain the existence of any links between them at individual site level.

5.5 It is not certain whether there exists a special and unique effect of VDT use on stress and health at work after the aggregated effect of environmental, job and organisational effects have been taken into account. As the main focii of the study are an examination of changes which may be occurring to the user's perceptions of their job design and job satisfaction, and the causes of the health problems due to the use of VDTs, the analysis looked at aggregate data for the four sites and for changes over the time span of the study on the main variables. The analysis was also extended to sub-group comparisons to ascertain if the amount of time spent working on the VDT, the wearing of

glasses, previous experience of using a VDT, or job level had any significance. Student's t-test was the statistical technique used in this analysis (see Chapter 12).

5.6 The potential causal factors were described and interrelationships suggested in the model described earlier (Section 4.2). The post-implementation version of the model has the VDT variables added representing something different, and possibly unique, which is additional to the other causal variables. The first stage in the application of the model in the analysis was to gain an understanding of the underlying factors to many of the individual items in the questionnaire which had not been used in factorised form already. The three groups of variables that were explored by factor analysis were the office environment, health symptoms, and views of the VDT and computer system (Chapter 13). Once the factors had been determined they were used in the path analysis which was applied to the model. The relative importance of the predictor variables and their interactions is assessed by examining the amount of variance they explain in the four health outcome factors. A detailed description of the regression analysis technique used in the path analysis is described in chapter 14.

5.7 A number of research questions are addressed by the hypothesised causal processes of the model:-

1. Is the use of VDTs in the office providing a special contribution to the levels of stress and health symptoms experienced by their users?
2. Do the perceived job characteristics and the

user's job satisfaction change after the introduction of VDTs?

3. Does the use of VDTs interact with the office environment, workstation ergonomics,and the job characteristics to influence the health and well-being of the users?

6. THE CHILD BENEFIT CENTRE WASHINGTON

Chapter Summary

The background to the introduction of on-line VDTs into the Child Benefit Centre is outlined. The detailed findings from the questionnaire survey are described. The main parameters of the survey and their relationships are explored. The impact of the change on the administative asssistants is discussed.

1. BACKGROUND

6.1.1 The first case study concerns the responses of the administrative assistants (AA) working at the Child Benefit Centre which is located in Washington, Co Durham. The Child Benefit Centre (CHBC) receives claims to social security child benefit from the members of the public, considers the eligibility of the claimant to the benefit, awards or disallows the claim, and, in the case of the awarding of the benefit, makes and maintains payment. A central register or index is maintained of all claimants, both for those to whom benefit is paid or to those for whom payment is disallowed. In order for the clerks, who award the benefit payments, to carry out their tasks, copies of the claimants account are required. The process of obtaining a copy of the account had for a number of years been performed by administration assistants (AA), one AA working to a group of clerks. The AAs had previously obtained the copy record sheet through paper documents sent to the computer operations division.

The register of claimants was maintained on a large main-frame computer. The input and outputs from the computer are through a batch system process.

6.1.2 It was considered advantageous to introduce an on-line facility, using VDTs in the clerical work areas, linked to the batch system mainframe. The major advantages expressed by the organisation were:-

- improvement of service to the public,
- realisation of savings in the number of AAs,
- enhanced job satisfaction for the users of the new system,
- experience gained in the use of a VDT system as a precursor to more long term use of computer systems.

6.1.3 The AAs use VDTs to input requests to the computer register and obtain print-outs of the claimant's accounts. A number of other basic up-date functions are performed by the AAs on the claimants benefit accounts.

CHBC Computer System

6.1.4 There are 53 VDTs, each with a linked printer forming a single workstation. The workstations are dispersed throughout the clerical areas placed adjacent to the clerical staff's desks and shared by the 120 AAs. The workstations are available for use from 07.30 to 17.30 Monday to Thursday and 07.30 to 16.15 on Fridays. The staff work flexible working hours.

6.1.5 The target go-live date was the 21 July 1986, whereas the actual date the system went live was 27 October 1986. The delays in the commencement of live running of the system were

due, in the main, to late delivery of the equipment, and problems with the hardware and software in the preparation to live running.

6.1.6 During the "acceptance trial" a peak workload test produce a system response time of less than 4 seconds for 99.4% of the terminals. During the period from 3 December 1986 to 21 August 1987 the employer kept records of the reliability of the system. Over that period, consisting of 179 working days, the average was 92.12%. There were 83 days when some difficulty arose either with a single VDT through to the entire system not working; 36 occasions when availability was between 90% and 99.9%, and 47 occasions when availability was below 90%. Time lost through printer problem was 1% of the time available. The employer's records were discontinued when they considered that reliability of the system had improved to a very satisfactory level.

CHBC Training

6.1.7 The computer system is dealing with simple procedures,the input being mainly by use of numeric characters via the numeric pad on the keyboard. It was therefore considered that only a short period of training was required. General education of all levels of staff in the areas using the system took place through a specially commissioned video film dealing with:-

- general principles of the computer system and its functions at the Child Benefit Centre,
- examples of the system in use,
- ergonomic principles of workstation design,

- health and safety aspects of the use of the VDTs and printers.

6.1.8 The supervising grade trained the AA with the aid of a training guide. Time was made available for users to practice and consolidate the training. Training in the use of the system is now incorporated into the general training received by new users to the system since the go-live date. There is a comprehensive training manual and system's instructions manual for use by supervisors and users.

CHBC Office Environment

6.1.9 The VDTs are located in two buildings two and a half miles apart. The buildings were erected in the late 1960s. The offices are large open plan buildings with the VDTs located on the first and second floors. The artificial lighting in both buildings is by fluorescent tubes with diffussers. Venetian blinds were installed when the VDTs were introduced. The accommodation appears to be of a good standard though management knew before the survey commenced that one of the buildings (Durham House) was the poorer accommodation of the two. All the users were given the opportunity to have an eyesight test prior to using the VDTs.

6.2 SURVEY RESULTS

6.2.1 The biographical information for these respondents is shown in diagrams 6.1-6.3 (see pages 149-152). At Stage 1 completion of the questionnaire there were 54 (79.4%) female and 21 (20.6%) male respondents and at the Stage 2 completion 61 (74.4%) female and 21 (25.6%) male respondents. 18.3%

(20.6%) wore glasses and 7.3% (11.8%) wore contact lenses (the Stage 1 figures are shown in parenthesis).

Office Environment

Room Atmosphere

6.2.2 The respondents reactions to the office environment were varied in their degree of satisfaction of the parameters considered (ambient temperature, light and noise (see Table 6.1). 45.7% at Stage 2 considered that they "very often" found the temperatures comfortable during the Winter and 33.3% during the Summer. There are sizeable numbers reporting that they find the temperature varies too much (49.4% in winter), there is insufficient air movement (75.3% winter, 64.0% summer), and that it is too warm (54.4% winter and 79.7% summer). There was no improvement on the items from the level found before the system was installed to the post-implementation stage (applying a Mann- Whitney U Test). This result also occurred when only the respondents who completed the questionnaire at both stages were used. In comparison with the larger population drawn from the three other DHSS locations this site's respondents considered that they felt less satisfied; 51.5% on a regular basis with the ambient temperature in the winter and 49.4% in summer at the post-implementation stage.

6.2.3 People's perception of what is comfortable obviously varies. The fact that individuals cannot control their own environment was found in other studies (Hedge 1982, Wineman 1986) to be a major factor in dissatisfaction. Hedge (1982) reports that room temperature's were found by other researchers to be most comfortable in the range of 20-24C for

sedentary workers, which is confirmed by Sundstrom (1986) in his review of various studies. Dainoff (1982) reports complaints of draughts being as high as 52% among VDT operators. Cakir et al in their Berlin study found 50% complaining of excessive heat (Dainoff 1982).

Table 6.1: View of Office Environment (Reporting "Very often" or "Always")

	Stage 1		Stage 2	
	Winter	Summer	Winter	Summer
	%	%	%	%
Too Warm	47.6	86.6	54.4	79.7
Comfortable Temperature	39.7	20.9	45.7	33.3
Too Cold	39.7	1.5	25.9	2.7
Temperature varies	49.2	35.8	49.4	45.3
Temperature constant	28.6	34.3	34.6	40.0
No Air Movement	71.4	68.7	75.3	64.0
Draughts	27.0	17.9	24.7	22.0
Satisfactory Ventilation	22.2	25.4	27.3	14.7

Lighting

6.2.4 The lighting was regarded as satisfactory (see Table 6.2) by only 51.2%, which is considerably below one of the other survey sites (OCAO) with 90.3% "often" satisfied at the Stage 2 questionnaire completion. Sundstrom (1986) cites several studies which vary between 70-90% being satisfied with their lighting levels. There are significant percentage who thought that reflections, glare or too much light

troubled them but these are not as great as in some studies; for instance 70-80% glare and brightness (Stammerjohn et al, 1981), 80% VDT users and 60% for non-VDT workers (Brown et al 1982). There was no objective measurements made of the lighting levels for this study and no measurements were made at the planning stage of the VDT installation, although management carefully considered the siting of the workstations. In order to improve the situation, it is important to explore with individuals at CHBC the source of the experienced discomfort so that corrective action can be taken, such as ensuring the screen is placed at the correct angle to the windows and correct positioning under fluorescent tubes.

Table 6.2: Views about the Office Lighting (Reporting "Often" to "Always")

	Stage 1 %	Stage 2 %
Adequate Daylight	65.7	54.9
Reflection/Glare Flicker	32.8	34.1
Too Bright	25.4	32.9
Satisfactory	52.2	51.2
Too dull	10.4	14.6

Noise

6.2.5 The noise levels of telephones and conversation in the office were found too distracting for only 4.9% (Stage 2), which was exceeded slightly by those who were distracted regularly by office machines 6.1% (see Table 6.3). There was a significant difference between the scores at the two sites

for the noise from outside but not the other three noise items (Mann-Whitney U Test, Mean rank-Stage 1,81.36; Stage 2, 69.80; Z=2.06, P=.04). There was virtually no increase in the noise reported coming from office machines (6.0% to 6.1%) which could have been a possible effect of the VDT workstations. Though there are only a few workstations in these large open plan offices, which is also unlikely to influence the temperature of these rooms.

Table 6.3: Views about the Office Noise Levels (Reporting "Often" to "Always")

	Stage 1 %	Stage 2 %
Too Quiet	7.5	9.8
Too Distracting	10.4	4.9
Office Machine	6.0	6.1
Outside Noise	4.5	2.4

Furniture

6.2.6 The comfort of the chair is an important feature in the working environment, as is the suitability of the desk for the performance of the office worker's tasks and many ergonomic texts advocate special attention be paid to them (eg Cakir et al 1980; Grandjean 1984). 88.1% were generally satisfied with their desk and 79.1% with the comfort of their chair before the receipt of the VDTs. These levels have, however, deteriorated to 65.9% and 57.3% respectively but this shows no significant difference ($P<.05$) when comparing the means of the total scores between the pre-implementation and post-implementation questionnaires.

(Mann-Whitney U Test: Chair-Z=-.014 P=.99; Desk - Z=.12 P=.91).

Amount of VDT Use

6.2.7 The work of the AAs before the system was introduced was a routine, monotonous job. They spent a good deal of time on their feet filing and retrieving papers. When the system was planned it was thought to be of assistance for them to be able to sit for part of the day, and it would also add some small amount of variety to the job as well as learning and using another skill. At the same time, it was recognised by management that the AA's job at CHBC was not changed in any significant manner in other ways by the introduction of the on-line computer system. The amount of time spent by the AAs on the VDT was reported as less than one hour a day by 61% and 37.8% between 1 and 2 hours. One person only said they were working on the VDU more than 2 hours a day. 95% said they spent less than an hour at any one time on the VDT.

Job characteristics

6.2.8 The job characteristics scores obtained by the JCI measure in the questionnaires are shown in Diagram 6.4 (see end of chapter). The comparison of the scores reveal higher scores for the post-implementation responses on the characteristics of variety, dealing with others, and task significance responses, but none of these were statistically significant at $P<.05$.

Comparisons of the Job Characteristic Scores

6.2.9 The figures themselves convey more information if they are compared to other groups of respondents. Table 6.4 sets out the mean scores of other groups; a combined score from three DHSS sites and the original researchers findings for their respondents across a wide spectrum of white collar jobs. The combined DHSS sites are on all measures higher means than CHBC but this is probably due to the fact that CHBC has only the administrative assistant grade as respondents, whereas there are a wide range of grades included in the mean score for all the three sites. A number of studies suggest that lower level jobs have less motivating characteristics (Cherniss and Kane 1987). In order to enhance the level of job satisfaction among the younger age groups and junior grades in the organisation, the profile of their jobs would profit from examination and attention in particular given to the degree of variety, task significance and autonomy they perceive in their jobs.

Job Characteristics and other variables

6.2.10 An examination, by Mann-Whitney U Test of the JCI scores and other variables (gender, high and low educational qualifications) revealed, that for this sample, there is a significant difference between the two education levels on the amount of feedback the respondents perceive they have in their work (see Table 6.4a).

Table 6.4 Comparisons of Mean Scores for the Job Characteristics and Attitude Measures

	CHBC after computers installed		Study of 3 DHSS sites (OCHQ, CHBC, RD) after computers installed		Original Researchers	
	Mean	SD	Mean	SD	Mean	SD
Variety	2.66 (2.58)	.57	3.11	.74	2.93	.90
Autonomy	3.82 (3.89)	.63	3.84	.61	3.72	.83
Feedback	3.31 (3.44)	.70	3.39	.63	3.03	1.05
Task Identity	3.71 (3.60)	.89	3.76	.80	4.01	.95
Dealing with others	3.07 (3.02)	.73	3.29	.72	4.14	.98
Friendship	3.53 (3.54)	.71	3.54	.64	3.60	.96
Job satis faction	50.32 (46.34)	11.27	56.94	13.35	63.80	.94
Participation	14.37 (14.35)	3.24	16.40	3.76	17.06	3.55
Stress	27.26 (30.09)	8.07	25.13	7.52	12.73a	12.37b

NB: The figures in parentheses are pre-implementation scores

a = Male mean score of Banks et al (1980) population
b = Female mean score of Banks et al (1980) population.

Table 6.4a Comparison of scores for respondents Job Characteristics and attitude measures (post implementation) for the high and low educational qualifications (P<.05)

	Low qualifications Mean Rank (N=69)	High qualifications Mean Rank (N=11)	Z	P
Feedback	38.9	55.3	2.29	.02

Job Satisfaction scores

6.2.11 The job satisfaction and participation scores are shown in Table 6.4 and 6.5. The AAs at CHBC score considerably below the other sites, which are similar to the results of a recent study (Bell 1987) in one Northern Ireland government department, using the same job satisfaction measure, having a mean score of 57.50. There are significant differences between the job satisfaction scores for males (51.3 mean rank) and females (38.1 mean rank) (Mann-Whitney U Test - Z=-2.19, p=.03) and also a significant improvement between the two stages for job satisfaction but not for participation (Table 6.5). The fact that using the VDT had added some variety to a routine job may have helped in this respect. The AAs now have to go to the shared VDT sited away from their desks. However, the improvement in the job satisfaction score need not necessarily be due solely to the direct impact of the VDT. The additional contact and interaction by the supervisors during training, or managers showing more interest due to "keeping an eye" on how the new system is settling in, could influence this response.

6.2.12. The Pearson correlation coefficients for job satisfaction, participation and stress with the six job characteristics are shown at Table 6.5a. Participation is positively associated with autonomy (P<.01) and dealing with others (P<.05), whilst stress is negatively related to feedback (P<.01), dealing with others (P<.05), and friendship (P<.05). None of the job characteristics was significantly related to job satisfaction.

Table 6.5: Scores for Respondents Attitude Measures

	Before Go-live		After Go-live				
	Mean	SD	Mean	SD	df	T	P
Stress	30.09	8.90	27.26	8.07	136.71	2.01	.05
Partic-ipation	14.35	3.81	14.37	3.24	132.22	-0.02	.NS
Job Satisfac-tion	46.34	12.90	50.32	11.25	134.16	-1.99	.05

NB: Maximum scores possible: Stress = 60
Participation = 25 Job Satisfaction = 90

Table 6.5a Correlations among the Attitude Variables and the Job Characteristics (Post-Implementation) (N=81)

	Job Satisfaction	Participation	Stress
Variety	.28	.13	-.21
Autonomy	.09	.48**	-.17
Feedback	.27	.16	-.37**
Dealing with others	.22	.34*	-.29*
Task significance	.23	.27	-.26
Friendship	.09	.11	-.35*

* P<.05
** P<.01

Use of the VDT and the Job Satisfaction, Participation and Stress Measures

6.2.13 The amount of interaction by this group of staff with the VDT in any one day is not very large (See 6.2.7). Respondents who spend the greater amount of time on the VDT

reported the higher levels of job satisfaction but less autonomy in their job (Table 6.6a-b). Those who spend under one hour on the VDT between other duties or a break consider that they have more variety in their jobs than the small number who are using the VDT for longer spells (Table 6.6c). Why this should be so for such a relatively small difference in use needs exploring with more detailed task analysis.

Table 6.6 **Comparison of mean scores for respondents on the attitude measures (post-implementation) - one way analysis of variance - P<.05**

6.6a **Job satisfaction broken down by the average number of hours in a day on the VDT**

Hours	Mean	N	S.D.	
<1	48.10	50	11.53	F=3.59
1-2	54.26	31	8.85	P<.05
Site Population	50.32	81	11.27	

6.6b **Autonomy broken down by the average number of hours in a day on the VDT**

Hours	Mean	N	S.D.	
<1	3.98	50	11.53	F=3.59
1-2	3.57	31	.72	P<.05
Site Population	3.82	81	.63	

6.6c Variety in the job broken down by the maximum hours on the VDT without a break

Hours	Mean	N	S.D.	
<1	3.87	78	.60	F=5.05
1-2	2.96	4	.55	P<.05
Site Population	3.82	82	.63	

Views of the Computer System

6.2.14 Views of various aspects of the computer system show clearly that the users find the messages very clear (86.6%), commands are regarded as straightforward (82.9%), that it is of assistance in their job (75.6%) and it is easy to learn how to use (81.7%) (Table 6.7). A sizeable minority find that they have some difficulty in learning to use the system. It may be of some value in trying to find out whether this is so, in order that some remedial action can be taken, either to ascertain how the training can be amended to help this type of user in future or to give some additional training if the system is not fully understood after being used. A little over a third of the users find the system tiring to use which is in contrast to the high percentage of respondents who find the system clear, straightforward and of definite assistance to them.

6.2.15 Table 6.8 shows features of the VDT screen and keyboard which are regarded as unsatisfactory. There are clearly major concerns about the breakdowns which are experienced, 87.8% reporting this as a problem. The servicing is regarded as unsatisfactory by 53.7%. The user managers interviewed considered that this is probably a

reflection of the amount of disruptions experienced and the remoteness and inexperience of the ADP staff.

Table 6.7. Respondents views of the computer system (The percentage of respondents who "agree" or "agree strongly" with each item)

	%
The systems messages are easy to understand	86.6
The replies given by the system are very "businesslike"	48.8
Using the system requires a lot of concentration	41.5
The commands are all straightforward to use	82.9
I had considerable difficulty learning to use the system	15.4
The system does not provide me with the correct help	6.1
I had no difficulty learning to use the system	81.7
Some of the commands are rather obscure	8.5
The system is very tiring to use	35.4
The system is a real assistance to my work	75.6

6.2.16 The brightness and glare from the screen are of concern to a sizeable minority but the number of users reporting these difficulties is lower than other studies, which report between 30% and 60% (Hultgren and Knave 1974, Laubli et at 1980, Dainoff 1982, Rinalducci et al 1983). It is not known if the concern by 24.4% over the poor legibility of the documents is due to the design and layout of the forms or the longhand entries which are illegible on the forms handled by the AAs.

Table 6.8. Problems of the Visual Display Terminal (The percentage of respondents reporting "Often" to "Always")

	%
Flickering of the screen	8.5
Brightness of the screen	14.6
Contrast of the screen	8.5
Distance to the screen	6.1
Angle of the screen	1.2
The paper documents are not always clearly legible	24.4
The characters on the screen are not clearly recognisable	4.9
Glare on the screen	15.9
The response time of the system after keying s not adequate	57.3
The servicing is not adequate	53.7
Distance to the keyboard	3.7
Angle of the keyboard	3.7
Breakdowns causing interruptions	87.8

Attitude Variables and the Computer System

6.2.17 A Mann-Whitney U-Test (2 tailed) compared high and low scorers on the three variables, job satisfaction, participation and stress, with features of the screen and keyboard and found several of the groups significantly different. Generally these results indicate that the lower scorers for job satisfaction perceive that they have more problems with the clarity of the characters (Table 6.9). There is a similar trend for the job satisfaction groups over the quality of servicing and the amount of breakdown interruptions. They also consider that the computer does not

assist them as much as the higher scoring job satisfaction group.

Table 6.9. Comparison of the scores for the low and high job satisfaction groups on the computer system attributes - Mann-Whitney U Test (P<.05)

	Low job satisfaction (N=62) Mean Rank	High job satisfaction (N=20) Mean Rank	Z	P
The screen characters are unclear	44.1	33.5	-2.32	.02
Servicing is adequate	44.9	31.1	-2.32	.02
Breakdowns	44.3	32.9	-1.98	.05
The system gives assistance	38.2	51.7	-2.33	.02

6.2.18 A breakdown of the job satisfaction scores shows a linear relationship, with the users feeling the system assists them in their work (Table 6.9a), and reflects the findings established in several other studies (Bikson and Gutek 1983, NCC Publications 1986, Bikson 1987). Greater dissatisfaction with the features of the workstation and computer system were also found for higher stress scorers (Tables 6.10). The number of users, however, on some of these items who report an incidence level of "often to "always" are small, as can be seen in Table 6.8.

6.9a. Job Satisfaction broken down by the "System is of assistance to my work"

	Mean	N	S.D.
Strongly disagree	36.00	2	2.83
Disagree	44.33	3	12.50
Do not agree or disagree	47.00	15	9.65
Agree	49.24	33	11.58
Strongly agree	54.86	29	10.43
Site Population	50.32	82	11.27

Table 6.10. Comparison of the scores for the high and low stress groups on the computer system attributes - Mann-Whitney U Test (P<.05)

	Low Stress (N=34) Mean Rank	High Stress (N=46) Mean Rank	Z	P
Distance to screen	35.3	44.3	-2.19	.03
The documents are not clearly legible	34.7	44.8	-2.11	.04
The characters are not clear	33.9	45.4	-2.91	.004
Breakdowns	31.4	47.2	-3.20	.001
The commands are straightforward	49.8	33.6	-3.33	.001
The system does not help	31.8	47.0	-3.18	.002
The system is tiring to use	32.6	46.3	-2.69	.007
The system gives assistance	46.9	35.8	-2.25	.03

Users Health

6.2.19 The questionnaire issued to the users, before and after using the VDTs, explored the level of symptoms users experienced and the degree of stress associated with work. Table 6.11 (page 137) sets out the percentage of users expressing discomfort from "often" to "always" on a 19 item Health Symptom Inventory. Despite the items showing differences between the two stages (8 items an increase, 10 a decrease, 1 no change), a Mann-Whitney U Test (2 tailed) comparison of the mean scores for all the respondents for each symptom between the first and second completion of the questionnaire found that none were statistically significant, other than for "changed colour vision" (Table 6.11a), which should be ignored due to the single person reporting this symptom who did not complete a questionnaire at both stages.

6.2.20 The comparison with three other sites in DHSS, (RD, OCAO, and OG) shows a higher level of reported complaints than these other sites; Table 6.12 gives the percentages for comparison with the other three sites. In order to see if there was any gender effect on the responses on the Health Symptom Inventory, a Mann- Whitney U Test was conducted. Five of the nineteen symptoms were found to have significant differences, all of them having the female respondents with more high scores than the men (Table 6.11b). A similar examination was completed for the high and low dichotomous groups on the job satisfaction and stress variables (Table 6.11c-d). Eyestrain and neck pressure are influenced by all three variables, gender, low job satisfaction and high stress, with headaches being influenced by gender and high stress, and neck pressure by gender and job satisfaction.

There has been no analysis of the actual sick leave records to see if any relationship existed with the reports of ill-health symptoms, this would be important to see if there was a similar trend for absenteeism.

6.2.21 The mean scores for the respondents on the GHQ!2 measure (stress) are shown in Tables 6.4 and 6.5. The reduction in the mean score from 30.09 to 27.26 (the maximum stress score would be 60) is statistically significant (Table 6.5). The overall mean scores for the three DHSS sites are also shown in Table 6.4 for comparison purposes. The features of the computer system which are related to a significant increase in the stress scores have been commented upon the previous section.

The comparison of results between Emerson House and Durham House

6.2.22 Analysis was conducted on the data for any differences in the mean scores (Mann-Whitney U Test, 2 tailed) between the respondents in the two buildings, Emerson House and Durham House. The majority of the differences are related to the views expressed about the office environment. Without exception, on items where there is a significant difference, the office climate is seen as poorer by those working in Durham House - Table 6.13.

Table 6.11 **Health Symptoms reported as attributable to the respondents work. (The percentage reporting "often" to "always")**

	Before Go-live	After Go-live
	%	%
Eyestrain	52.5	52.5
Stiff Neck	59.3	55.0
Burning Eyes	19.4	22.5
Sore Shoulders	41.8	39.7
Back pain	49.3	48.7
Irritated eyes	25.4	29.7
Blurred vision	19.4	16.2
Stiff arms	13.4	20.0
Stiff legs	14.9	15.0
Neck pressure	40.3	33.7
Skin rash	6.0	6.2
Stomach pains	4.5	3.7
Swollen joints	7.5	7.5
Hand cramps	13.5	7.5
Sore wrists	9.0	6.2
Changed colour vision	1.5	-
Fainting	1.5	-
Loss in fingers	-	1.2
Headaches	49.3	51.2

Table 6.11a. Comparison of the scores between Stage 1 and Stage 2 on the Health Symptom Inventory - Mann-Whitney U Test (P<.05)

	Pre-Implementation Mean Rank (N=67)	Post-Implementation Mean Rank (N=80)	Z	P
Changed of colour vision	77.8	70.8	-2.27	.02

Table 6.11b. Comparison of the scores by gender on the Health Symptoms - Mann-Whitney U Test (P<.05)

	Female (N=59) Mean Rank	Male (N=21) Mean Rank	Z	P
Eyestrain	43.5	32.2	-1.98	.05
Stiff Neck	43.6	31.8	-2.07	.04
Sore Shoulders	44.4	29.6	-2.59	.01
Neck Pressure	44.3	29.8	-2.55	.01
Headaches	44.4	29.5	-2.61	.01

Table 6.11c. Comparison of the scores for the high and low job satisfaction groups on the Health Symptoms - Mann-Whitney U Test (P<.05)

	Low job satisfaction (N=60) Mean Rank	High job satisfaction (N=20) Mean Rank	Z	P
Eyestrain	45.1	26.9	-3.14	.002
Stiff Neck	43.5	31.6	-2.05	.05
Irritated eyes	44.9	27.2	-3.14	.002
Neck pressure	44.1	29.7	-2.50	.01
Hand cramps	43.1	32.7	-2.19	.03

Table 6.11d. Comparison of the scores for the high and low stress groups on the Health Symptoms - Mann-Whitney U Test (P<.05)

	Low stress (N=34) Mean Rank	High stress (N=46) Mean Rank	Z	P
Eyestrain	34.6	44.9	-2.02	.04
Irritated eyes	34.4	45.0	-2.16	.03
Neck pressure	33.5	45.7	-2.40	.02
Skin rash	36.4	43.5	-2.10	.04
Sore wrists	34.7	44.8	-2.41	.02
Headaches	33.1	46.0	-2.53	.01

Table 6.12. **The percentage of respondents stating "often" to "always" for the Health Symptoms Inventory (Stage 1)**

Health Symptom	OCAO	RD	OG	CHBC
Eyestrain	20.6	20.0	34.1	52.2
Stiff Neck	2.9	11.9	25.6	59.3
Burning Eyes	5.8	5.3	15.2	19.4
Sore Shoulders	-	9.3	16.5	41.8
Back pain	8.8	12.0	17.1	49.3
Irritated eyes	8.8	10.7	24.4	25.4
Blurred vision	5.8	5.4	15.2	19.4
Stiff arms	2.9	1.3	5.1	3.4
Stiff legs	-	2.6	9.1	14.9
Neck pressure	-	8.0	15.9	40.3
Skin rash	-	1.3	3.0	6.0
Stomach pains	2.9	1.3	-	4.5
Swollen joints	-	2.7	0.6	7.5
Hand cramps	-	2.7	8.5	13.5
Sore wrists	-	-	4.3	9.0
Changed colour vision	-	-	0.6	1.5
Fainting	-	-	-	1.5
Feeling loss in fingers	2.9	-	1.2	-
Headaches	11.7	12.0	5.4	49.3

Table 6.13. Items where there are significant differences (P<.05) between respondents in the two buildings at the Child Benefit Centre at the post-implementation stage -Mann-Whitney U Test

	Emerson House (N=61) Mean Rank	Durham House (N=20) Mean Rank	Z	P
Winter Office Environment				
It is comfortable	44.9	29.3	-2.74	.006
It is too cold	34.8	69.0	-4.45	.0000
The temperature remains constant	44.6	30.0	-2.52	.01
The ventilation is satisfactory	44.8	29.6	-2.72	.006
Summer Office Environment				
It is too cold	33.9	50.2	-3.36	.0008
The temperature varies throughout	35.2	46.3	-2.02	.04
Health Symptoms				
Burning eyes	37.5	49.5	-2.29	.02
Stomach pains	38.1	47.6	-2.33	.02
Fainting	38.5	46.5	-3.53	.0004
Headaches	36.1	53.7	-3.01	.003

6.2.23 The differences found between the two buildings on the health symptoms indicate four which are significantly different (burning eyes, stomach pains, fainting and headaches - Table 6.13). The percentage of respondents reporting these symptoms regularly are large for both burning eyes and headaches. This cannot however be

attributed to the lighting differences as fewer people report problems with the daylight at Durham House and the respondents do not have any differences in their reactions to the artificial lighting.

6.2.24 There appears to be no influence upon the stress, participation and job satisfaction scores by the environmental differences because there is no significant difference between the two groups at either stage. Even though there is no statistical significance in the difference there is a slightly higher score on the job satisfaction measure at both stages of completion by Emerson House respondents.

6.3 DISCUSSION

6.3.1 The users at this site are all administrative assistants (AA) doing very routine jobs. The VDTs have been introduced to improve the efficiency of the processing of the child benefit claims. The amount the VDT is used in the working day by any one AA is not very large, the majority of the respondents using it between 1/2 hour and 2 hours a day. The changes in the job procedures due to the introduction of the VDTs have consequently not been very fundamental though management thought it would assist in giving some added variety to the AA's jobs.

6.3.2 Due to the routine nature of their work it is not surprising that they perceive their jobs as lacking in variety and dealing with others. The job also provides them with a level of feedback and task identity which is lower

than the mean scores at other DHSS sites. This still holds true if the clerical grades are separated out at the other sites.

6.3.3 The influence of the education level of these respondents has an effect upon the way the feedback in the job is perceived. The higher the job satisfaction levels, the higher people usually rate the various job characteristics. Other research has found that restrictive job characteristics have been found to be associated with mental strain (summarised in Beehr and Newman 1978; Glowinski and Cooper 1986). It would be particularly advantageous for his group of respondents to have more variety in their tasks. It would also be worthwhile exploring in more detail the underlying reasons for the greater level of stress and lower job satisfaction for these AAs than the scores at the other DHSS sites.

6.3.4 The introduction of the VDT has probably been an influence on the reduction of the level of stress. There was generally a positive attitude to the computer because of the assistance it gave to them in their work. A relatively modest percentage of the respondents found that the computer system presented difficulties of learning but 75% said it was of real assistance to them. On the other hand other contributory factors in this improvement could be due to the Hawthorne effect; of the additional attention through extra training given for the use of the VDT, the interest supervisors and managers gave the users as the VDTs were being introduced and during the initial period of use.

6.3.5 It is now a well documented experience that participation by the "real end-users" in any programme of technological change is beneficial to the improvements sought from the new systems. There have been a number of different standpoints surrounding the advocacy of user participation. The management of change processes are aided by involvement at an early stage in the design process (Hawgood et al 1978; Yin et al 1976; Mumford 1980; Matherley and Matherley 1985); the acceptance, use, and reduction in resistance by users is assisted (Mumford 1980; Eason 1982; Mainiero and DeMichiell 1986; Sumner 1986; Bikson 1987); the user-machine interface is enhanced (Eason 1982; Eason 1983; Eason 1987); and the improvement in organisational performance is sought (Blackler and Brown 1986; Coombes 1986; Hirschheim and Feeny 1986; Bikson, 1987). The level of participation at this site was restricted to union representation on the Steering Committee for the project and a two weeks trial by a few users prior to the "go-live" date. The user's view about participation in workplace decisions did not change significantly for these users during the period of the enquiry. It was also strikingly noticeable that their scores on participation were well below the other DHSS sites. One important arguement for greater involvement within an organisation is that improvement of the work systems can be achieved through the dynamic processes of involving members of the organisation at all levels.

6.3.6 The incidence of breakdowns is clearly of a serious nature and not only did a large percentage of users consider it a problem in answer to the specific item in the questionnaire, but it also merited comment from many users in

the section of the questionnaire inviting comments. The level of difficulty may not be the result only of the actual number of breakdowns, but the position could be exacerbated by the lack of immediate assistance due to the lack of a clear path of communication to the ADP staff who can assist with the problems. The fact that the ADP staff are situated at a sight several miles from the users also creates difficulty for assistance being readily available. The user's managers also thought that there had been a high turnover of ADP staff and their inexperience is reflected in the handling of breakdown situations and getting speedy recovery.

6.3.7 Despite the health symptoms in the main not showing any statistically significant deterioration between the two stages, as other commentators may have led us to expect (eg Bradley 1983; Evans 1985; Dy 1985), it is a matter for concern that the overall level of symptoms being reported are so much higher than the other DHSS sites. These levels of discomfort and ill-health are similar to some reports for other traditional office workers but higher than others (Donoghue 1983; Laubli and Grandjean 1984; Sundstrom 1986; Grandjean 1987). The respondents' views may be in addition influenced by their feelings about their job characteristics and job satisfaction.

6.3.8 In contrast the decline in the level of stress between the two stages of the study at this site is an important finding. If some of the features of the VDT could be examined which have links in this group of clerical staff with their levels of stress (see Table 6.10), there could well be further improvements achieved. However, no account has been

taken as to whether self-reported illness manifests itself in increased sick leave or absenteeism at this site. It is likely, however, that the level of ill-health, reflected by the symptom check list results, will correlate with actual absence rates as was found by Gobel and Meers (1982).

6.3.9 The reactions to the office environmental noise were not as adverse as found in some studies. Other researchers (Stewart 1980; Cane et al 1984; Lindstrom and Vuori 1984; Hedge 1986; Sundstrom 1986; Wineman 1986) found between 45%-61% were distracted or interrupted in their work by telephones or conversation compared with 4.9% to 10.4% at CHBC. Sundstrom (1986) reports (page 133) studies where office machines were a disturbance for 25% compared to 5.0% in this sample.

6.3.10 There were no measurements made of the lighting levels in working areas for this study. The lighting levels were satisfactory for approximately 50% so could be improved for just under half of the respondents, with approximately a third of them finding that reflections and glare are a problem. One of the problems for a mixed job environment is that the levels recommended for VDT and traditional clerical work are different, besides the needs of individuals also differing. One possible solution is to have subsidiary lighting available under the control of staff at individual work places. This form of control is a small but important contribution to the control that can be given to the individual worker (Hedge 1982; Wineman 1986). This can make an important contribution to employees establishing a degree of control over their working environment. It is frequently

found in stress research that a lack of control is a prime source of stressful feelings at work (Kasl 1978; Crump et al 1980; Karasek 1979; Schuler 1980; Beehr and Newman 1978; Tetrick and LaRocco 1987). Examination of the lighting levels may also contribute to reducing the high levels of reported eyestrain at this site; 52% at Child Benefit Centre compared with between 20% and 34% at the other three DHSS sites.

6.3.11 The dissatisfaction with the office climatic conditions is a significant problem, more so for Durham House than for Emerson House. It is a major problem for the satisfactory management of office climates that there is such a wide range of views about the desirable temperatures, humidity and air movement. The lack of personal control has been found to be a major dissatisfaction and any improvements that can be achieved in employee's perceptions about the office environment would probably reduce both the general level of dissatisfaction and feelings of stress. It is not possible, of course, to achieve maximum benefits for everyone, but aiming for an optimum level of acceptance could pay dividends.

6.3.12 Finally, the findings indicate that the traditional office worker has to contend with annoyance and dissatisfaction which may well contribute to increased levels of stress and ill health. These problems remain after the introduction of an on-line computer system at similar levels of dissatisfaction. With the introduction of the computer system there was found to be an improvement in the levels of job satisfaction and a reduction in the level of stress. In addition the functionality of the system was appreciated and with an improvement in the system's performance could

contribute more significantly towards further improvements in the staff's attitudes to their jobs.

Summary

6.3.13 The office environment at this site has a marked impact on the respondents' level of dissatisfaction. There was lower satisfaction with the lighting levels than with other populations previously researched (Sundstrom 1986). Despite the respondents working in the same organisation and in the same jobs there was a building specific reaction to health symptoms but not to the attitude variables. In comparison with other studies the noise levels created very little concern to the majority of the respondents.

6.3.14 An important feature, in respect of the focus of the study, was the very low level of use of the VDTs; 97.8% working less than two hours a day on the VDT. There were marginal improvements to the JCI dimensions of variety,task significance, and dealing with others but not to a significant level.The job satisfaction score improved and the stress levels reduced over the period of the study. However because of the low use of the VDTs causation could not be directly attributed to the VDTS.

6.3.15 There were high levels of satisfaction with the VDT characteristics other than the system response times and the reliability of the system. On the whole the VDT did not appear to have made a large impact on this groups job characteristics but had contributed in a small way to reducing stress and increasing job satisfaction.

Diagram 6.1

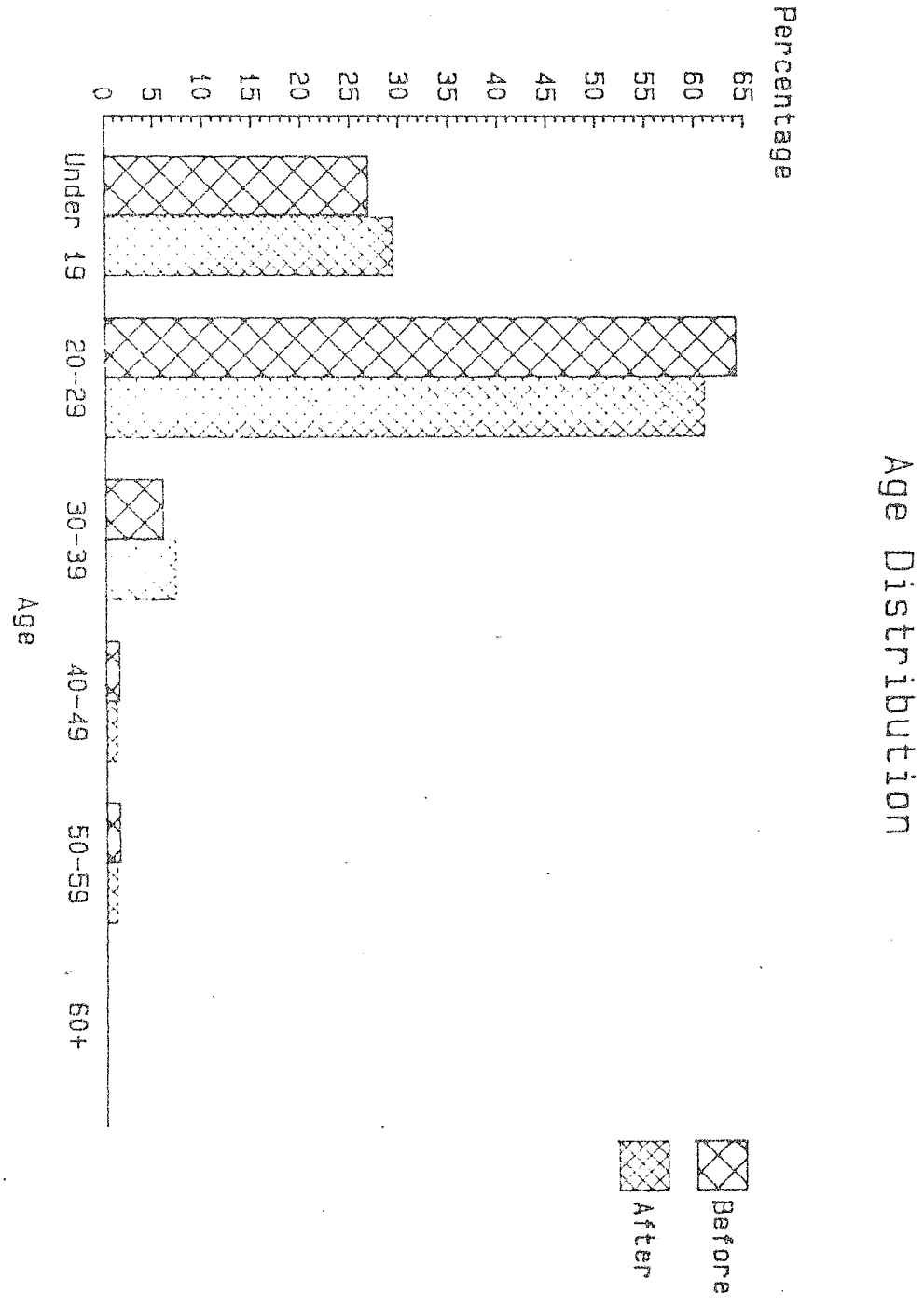

Age Distribution
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Age
Under 19
20-29
30-39
40-49
50-59
60+
Before
After

Diagram 6.2

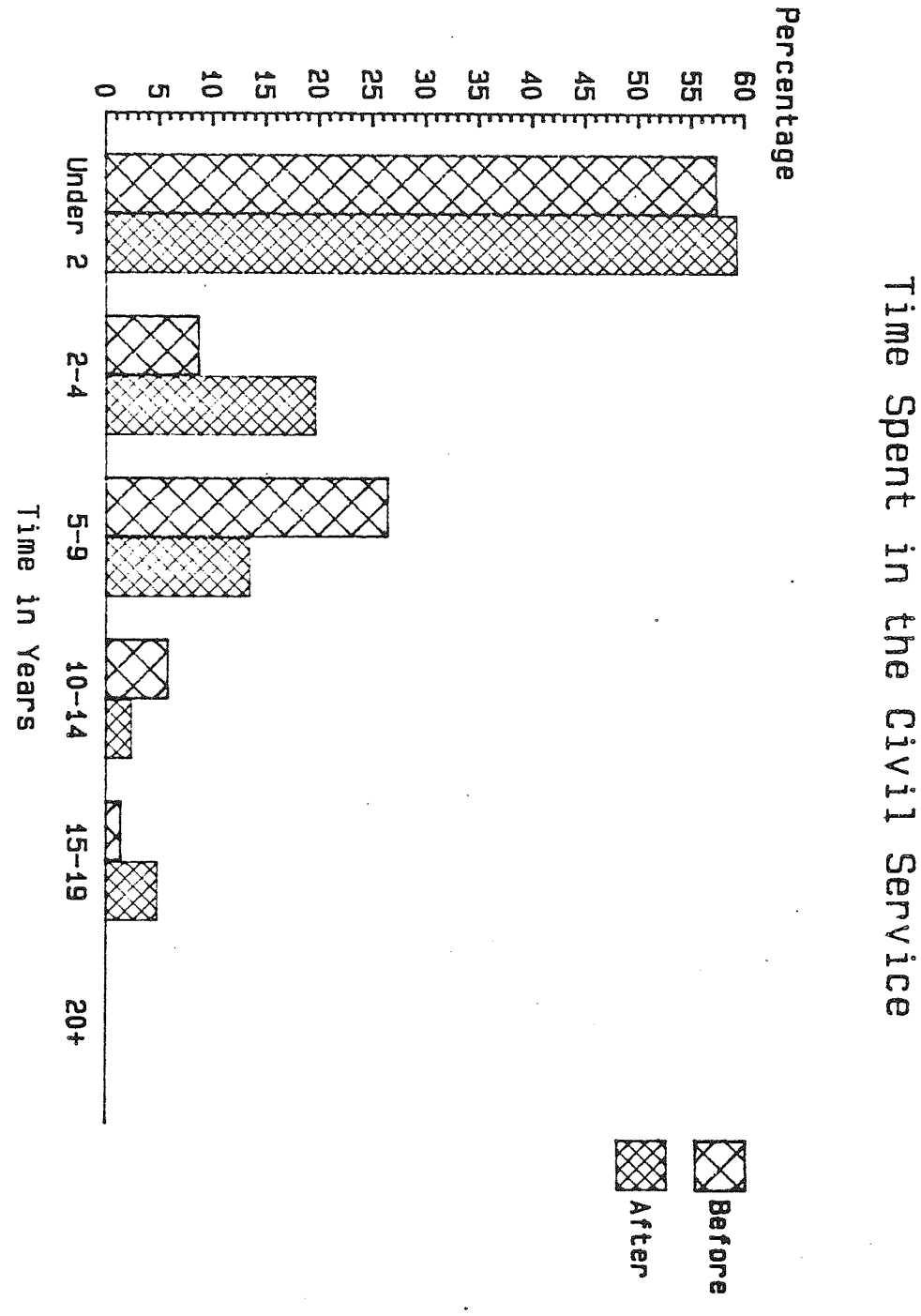

Time Spent in the Civil Service
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
Under 2
2-4
5-9
10-14
15-19
20+
Time in Years
Before
After

Diagram 6.3

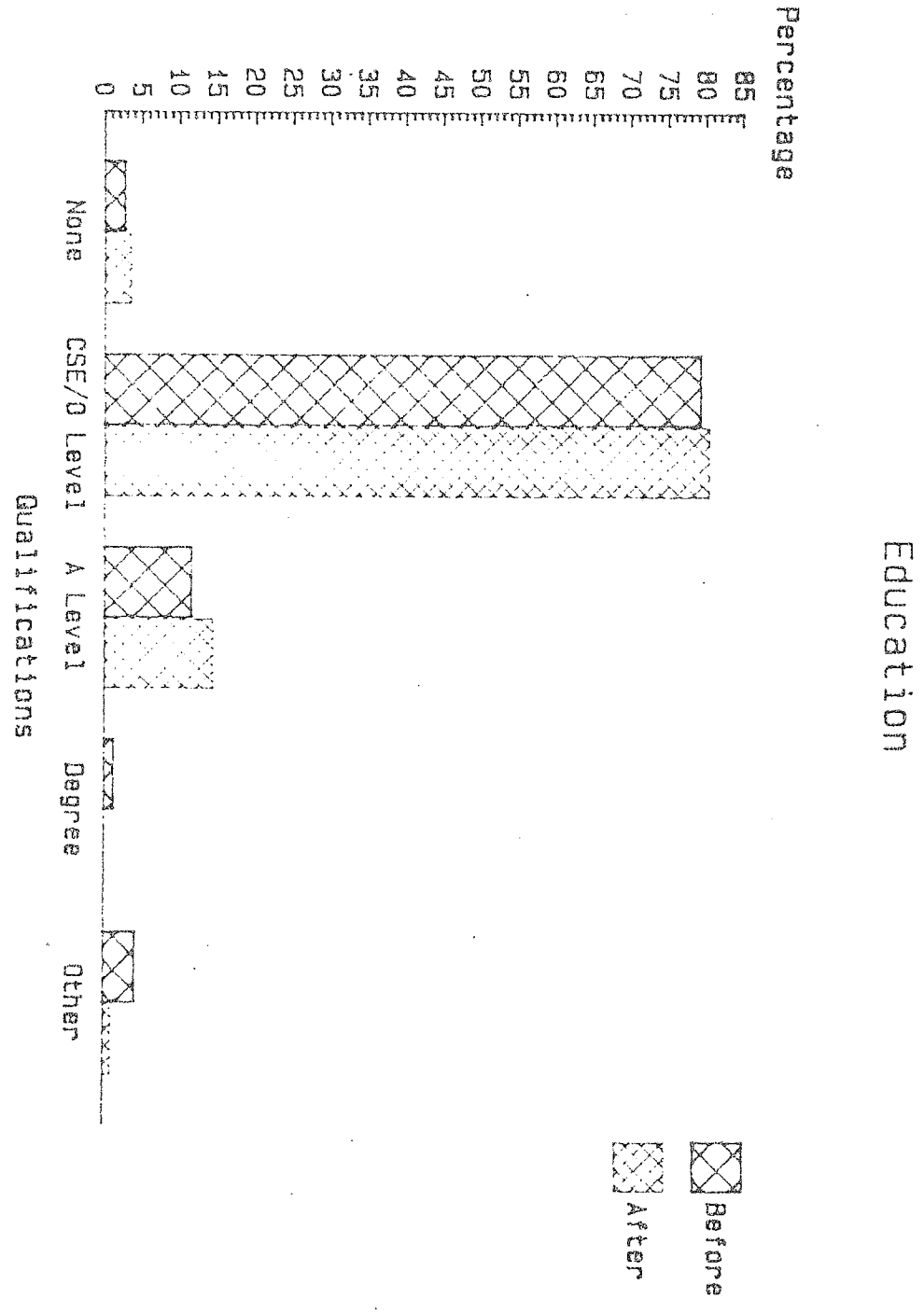
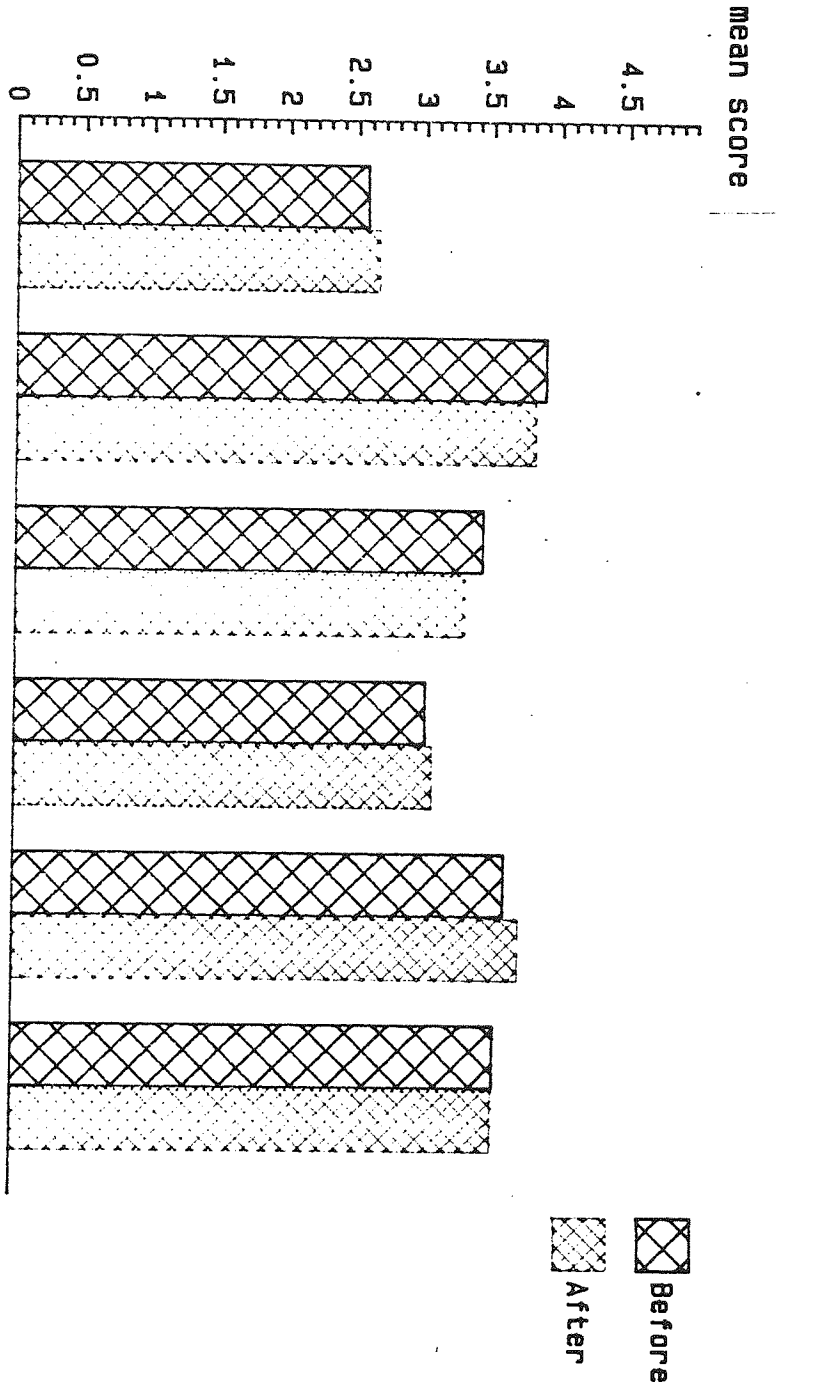

Education
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
None
CSE/O Level
A Level
Degree
Other
Qualifications
Before
After

Diagram 6.4


Job Characteristics
mean score
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Variety
Autonomy
Feed back
Dealing with others
Task Significance
Friendship
Characteristics
Before
After

7.THE PENSIONS BRANCH OF OVERSEAS GROUP AT NEWCASTLE-ON-TYNE

Chapter Summary

The background to the introduction of on-line pensions system for the administative officers at Overseas Group is described. The detailed results of the survey for this site are given and the relationships between the variables are explored. The impact of the use of the VDTs on the administative officers is discussed.

7.1 BACKGROUND

7.1.1 This second case study concerns the responses obtained from the clerical staff (administration officers - AO) at the Pensions Branch of the Overseas Group at, Newcastle-on-Tyne. The Overseas Group, Pensions Branch (OG) deals with claims by retirement and widow pensioners and their dependants who live abroad. The initial claim to the benefit was received in the Awards Section of the Branch from the pensioner. The claim was considered for eligibility, and payment of benefit awarded or disallowed by the Section, which also initiated the first payment of the pension. These clerical sections passed the papers to a batch processing computer operation which also set up a claimants file on the computer database. All further handling of the claimant's case was by the Payments Section who dealt clerically with any subsequent payments and enquiries on the claim through interaction with the batch processing computer system.

7.1.2 It was decided by management to install on-line VDTs for use in oth sections so that the clerks could have more ready access to the claimant's computer file once it had been set up. The advantages being sought by management were:-

- improvement of service to the public,
- realisation of savings in the number of clerks dealing with these cases,
- experience gained by staff in the use of computers as a forerunner to long-term developments of computer systems dealing with pension cases,
- enhanced job satisfaction for the users.

7.1.3 The clerks use the VDTs to examine the pensioner's claim file once it has been entered on the database and if required can obtain a hard copy from the printers in their room. They are unable to make any direct inputs to the database being limited to enquiries only, though they can instruct, via the VDT, the main computer programme to prevent or release a pension payment from the next payment run. The functionality of the system is therefore quite limited. Amendments have to be processed through the batch processing operations.

The OG Computer System

7.1.4 There are 103 VDTs in the Payments Section, one for each clerk, and 4 VDTs in the Awards Section for shared use by 110 clerks. The majority of the tasks undertaken by the Awards Section clerks are dealing with the claims prior to input to the computer. The VDTs are Newbury data 9500 dumb terminals linked to an ICL 2988 mainframe machine. The

mainframe is located in a separate building to the clerks. Several controllers are situated in a small room next to the Payments Sections. There are three printers for the Payments Section and one for the Awards Section. The printers with acoustic hoods are located in the clerks' open plan offices. The VDTs are generally available, for use between 7.30 am and 6.00 pm, Monday to Friday. The staff work flexible working hours.

7.1.5 The target go-live date was originally January 1987 but considerable problems with static electricity were encountered during the acceptance trials. Eventually, after the VDTs were removed and the problem resolved by additional components being added, the acceptance trials were completed in early 1988 and the system "went live" on the 8 February 1988.

7.1.6 During the "acceptance trials" there was no test of the system response time but it is generally considered to be between 3 and 4 seconds.

OG Training

7.1.7 The background training session on information technology was completed in two sessions by a Departmental central training team. The contents of this session were:-

- background to the introduction of the system,
- how to use the VDT and hands-on experience of a mock dialogue,
- health and safety issues,
- workstation layout and adjustments explaining the ergonomic implications.

A written handout covering these aspects was issued to each course member at the end of the two hour session.

7.1.8 Even though the computer system gave assistance to very basic work procedures, the skills training for using the computer system was regarded as very important and a 1.5 hours to 2 hours session was given to all the users. The system procedures, how to access the system and use the different functions, were explained in detail and a short practice period was integrated into the session. A user guide was produced for subsequent support and a help desk is provided by the systems branch to help with any user problems. The training programme was considered adequate by the managers because of the limited functionality of the system.

OG Office Environment

7.1.9 The Awards Sections are located in two single story buildings with large open plan rooms. These buildings are refurbished second World War army buildings. They have central heating. The Payments Section are on the 1st and 2nd floors of a three storey modern building built in the early 1970s. It has central heating but is not air conditioned. The staff are in large open plan rooms. The accommodation appears to be of a reasonable standard.

7.1.10 The lighting in all these buildings is by fluorescent tubes with diffusers. Venetian blinds were installed when the VDTs were provided. All the users were given the opportunity to have an eyesight test prior to using the VDTs.

7.2 SURVEY RESULTS

7.2.1 The biographical information for these respondents is shown in diagrams 7.1-7.3 (see pages 188-191). At Stage 1 completion of the questionnaire there were 106 (64.6%) female and 58 (35.4%) male respondents, and at the Stage 2 completion 89 (70.1%) females and 38 (29.9%) male respondents. The proportion of male to female respondents is similar to the administrative assistants at CHBC but a much smaller proportion of male respondents than the third and fourth sites which have a higher proportion of higher graded jobs.

Office Environment

Room Atmosphere

7.2.2 The respondents reactions to the office environment were varied in their degree of satisfaction of the parameters considered (ambient temperature, light and noise - see Table 7.1). At Stage 2 nearly half considered that they "very often" found the temperatures comfortable during both the Winter (41.3%) and the Summer (43.7%). There are sizeable numbers reporting that they find the temperature varies too much (48.2% in winter), there is insufficient air movement (69.8% winter, 65.1% summer), and that it is too warm (27.0% winter and 62.7% summer). As a comparison with the larger population drawn from the three other DHSS locations, 51.5% considered that they felt satisfied on a regular basis with the ambient temperature in the winter. On the whole, there is no clear picture of improvement on the ambient environmental items from the level found before the system was installed to the post-implementation stage. A

Mann-Whitney U Test found only one item (comfortable temperature (winter)) with a significant difference between each stage at a significance level of P<.05 (Table 7.1a).

Table 7.1: View of office environment (Reporting "Very Often" or "Always")

	Stage 1 (N=164)		Stage 2 (N=127)	
	Winter %	Summer %	Winter %	Summer %
Too Warm	7.5	27.8	27.0	62.7
Comfortable Temperature	16.1	8.2	41.3	43.7
Too Cold	11.2	2.5	38.9	4.8
Temperature Varies	21.1	19.0	48.2	44.4
Temperature Constant	12.4	10.8	25.4	26.2
No Air Movement	45.5	46.2	69.8	65.1
Draughts	25.6	12.7	49.2	25.4
Satisfactory ventilation	6.8	5.7	25.8	21.4

Table 7.1a. Comparison of mean scores for respondents views of the office environment - Mann-Whitney U Test (P<.05)

	Before (N=161) Implementation Mean Rank	After (N=126) Implementation Mean Rank	Z	P
Comfortable Temperature	151.9	133.9	-1.98	.05

7.2.3 The two buildings occupied by these respondents give rise to contrasting responses which are explored at

paragraphs 7.2.23 to 7.2.25. On the combined percentages for the two buildings, as set out in Table 7.1, this site has the highest percentage of satisfied respondents with regard to the comfort of the temperatures.

Lighting

7.2.4 There were no objective measurements made of the lighting levels. The lighting was regarded as satisfactory (see Table 7.2) by only 55.6%, which is considerably below the OCAO finding with 90.3% "often" satisfied at the Stage 2 questionnaire completion. There are significant percentages who thought that reflections, glare or too much light troubled them. Lights being too bright due to the recommended illuminance levels being exceeded is a recognised problem (Goacher, 1980) and it is well reported that glare, reflection and flicker can cause problems for the traditional officer worker as well as those using VDTs (Goacher 1980, Stewart 1980, Hedge 1982, Cane et al 1984, Hedge 1986). These authors report dissatisfied levels for respondents of between 42% and 81%.

Table 7.2: Views about the office lighting (Reporting "Often" to "Always")

	Stage 1 (N=164) %	Stage 2 (N=127) %
Adequate Daylight	51.5	69.0
Reflection/Glare Flicker	40.5	31.0
Too Bright	39.3	29.4
Satisfactory	47.9	55.6
Too Dull	12.9	19.9

Noise

7.2.5 The noise levels of telephones and conversation in the office were found too distracting for only 18.3% (Stage 2) which was considerably higher than the number who were distracted regularly, by office machines and outside noise (see Table 7.3). This is probably the result of working in large open plan rooms (Hedge 1986, Sundstrom 1986, Wineman 1986). There was a significant difference between the scores at the two stages for the noise items "office machines" and "outside noise". Table 7.3a shows that the mean scores lie between "never" and "occasionally" on the Likert 1-5 scoring scale. Even though there are statistically significant differences between the two stages of completion, for the respondents who completed the questionnaire at both stages as well as all the Stage 2 respondents, the low scores indicate that there is no real problem for the majority of respondents. Other studies (Stewart 1980, Cane et al 1984; Hedge 1986; Sundstrom 1986) have found higher levels of internal distractions, between 45% and 61%. There was no large increase in the noise reported coming from office machines (1.2% to 2.4%) which is reported by a very small number of respondents as being a disturbance.

Table 7.3: Views about the office noise levels (Reporting "Often" to "Always")

	Stage 1 (N=164) %	Stage 2 (N=127) %
Too Quiet	5.5	5.6
Too Distracting	20.2	18.3
Office Machine	1.2	2.4
Outside Noise	5.5	7.9

Table 7.3a. Comparison of mean scores for the significant noise items between Stages 1 and 2 (P<.05)

	Mean Rank	N	Z	P
Noise - Office Machines				
Before	151.9 (138.8)	161 (161)		
After	133.9 (125.5)	126 (106)	-1.98 (-1.50)	.05 (.13)
Noise - from outside				
Before	127.3 (119.7)	163 (163)		
After	167.9 (157.5)	126 (106)	-4.61 (-4.39)	.0000 (.0000)

NB Figures in parenthesis are for those who completed the questionnaire at both stages.

Furniture

7.2.6 All the staff in the Payment Section had received a new five legged adjustable chair and a new desk when the VDTs were installed. The shared workstations in the Awards section had new chairs and desks but no replacements of the existing furniture was made. 76.7% were generally satisfied with their

desk and 68.7% with the comfort of their chair before the receipt of the VDTs. These levels have, however, deteriorated to 61.1% and 64.3% respectively at Stage 2. When all respondents' scores at both stages are compared significant difference are found between them (Table 7.3b). There is a deterioration found in the comfort of both desks and chairs after the VDTs were put in place. The users did not receive new desks and even though they conformed to the recommended measurements (eg Cakir et al 1980) the VDT was limiting the space available on the desk for working on their papers.

Table 7.3.b. Comparison of scores for the furniture items between Stages 1 and 2 - Mann-Whitney U Test (P<.05)

	Mean Rank	N	Z	Level of Significance
Desk				
Before	158.1 (145.0)	163 (163)	-3.10 (-2.83)	P<.002 (P<.005)
After	128.1 (118.2)	126 (106)		
Chair				
Before	155.5 (141.1)	163 (163)	-2.48 (-1.77)	P<.01 *(P<.08)
After	131.4 (124.2)	126 (106)		

* This comparison is non-significant at P<.05.

NB Figures in parenthesis are for those who completed the questionnaire at both stages.

Amount of VDT use

7.2.7 It was recognised by management at OG that the AO job in the Awards Section had not changed in any significant manner by the introduction of the on-line computer system, though the obverse was expected for the Payment Section. Table 7.4a gives the details of the time spent by the 100 users on the VDT in any average day; over 42% spending over 3 hours a day. Table 7.4b sets out the different distribution of time spent on the VDT between Awards and Payment Section. The great majority spend less than 1 hour in any continuous spell of use of the VDT (Table 7.4c) which is well within the recommended maximum hours period of use without a break (Purdham 1984, Knave et al 1985, Health and Safety 1986, Cakir et al 1980, Dy 1985). 93% said they spent less than an hour at any one time on the VDT. Due to the nature of the clerks jobs it is questionable that any of them should report using the VDT for more than one hour continuously so there may be an element of mis-reporting to this question. There were 27 Awards Section respondents who said that they did not use the VDT. The difference in the time spent on the VDT between the Sections is due to the difference in the work procedures in each section and the sharing of 4 VDTs by the Awards Section's 110 AOs. Those in the Awards Section who do not use the computer get an AA to do the small amount of work that is required of the system.

Table 7.4a - Time spent on average on the VDT in a day

Hours	N	%
Less than 1	41	41.0
1-2	17	17.0
3-4	31	31.0
5-6	11	11.0

Table 7.4b. Time spent on average on the VDT in a day broken down by sections

	Awards		Payments	
	No	%	No	%
Less than 1 hour	32	97.0	9	13.4
1-2 hours	1	3.0	16	23.9
3-4 hours	-	-	31	46.3
5-6 hours and more	-	-	11	16.4
	33	100	67	100

Table 7.4c. Maximum number of hours spent on the VDT without a break

Hours	No	%
Less than 1	93	93.00
1-2	6	6.00
3-4	1	1.00

Job Characteristics

7.2.8 The job characteristics scores obtained from the JCI

measure in the questionnaires completed by the respondents are shown in Diagram 7.4 (see end of chapter) and Table 7.5. The comparison of the scores between the stages reveals a lower post-implementation score for task significance as the only statistically significant change (Table 7.5a). The other differences in the scores, some higher and others lower, will probably be due to the differences in the two populations of respondents; some respondents at Stage 2 not having completed the questionnaire at Stage 1. If a comparison is made of the scores of those respondents who completed the questionnaire at both stages there is no statistically significant difference ($Z=-1.83$, $p=.07$).

Comparisons of the Attitude Variable Scores

7.2.9 Table 7.5 sets out the mean scores of other groups for comparison purposes; a combined score from the three other DHSS sites and the original researchers findings for their respondents across a wide spectrum of white collar jobs. On five measures the three combined sites have lower means than OG. The post-implementation job satisfaction and stress scores compare favourably with the mean score of the other three sites but are all lower than the original researchers sample for job satisfaction. Despite the participation score increasing between Stages 1 and 2 it is still marginally lower than the combined sites. A recent study (Bell, 1987) in one Northern Ireland government department using the same job satisfaction measure had a mean score of 57.50.

Table 7.5. Comparisons of mean scores for the Job Characteristics and Attitude measures between sites

	OG After computer installed		Study of3 DHSS sites after computers installed (CHBC, OCAO, RD)		Original Researchers	
	Mean	SD	Mean	SD	Mean	SD
Variety	3.54 (3.36)	.38 (.51)	3.11	.74	2.93	.90
Autonomy	3.76 (3.85)	.50 (.48)	3.84	.61	3.72	.83
Feedback	3.61 (3.58)	.61 (.61)	3.39	.63	3.03	1.05
Task Identity	4.07 (4.24)	.66 (.60)	3.76	.80	4.01	.95
Dealing with others	3.38 (3.24)	.58 (.64)	3.29	.72	4.14	.98
Friendship	3.63 (3.58)	.48 (.56)	3.54	.64	3.60	.96
Job satis -faction	59.77 (59.74)	10.41 (10.03)	56.94	13.35	63.80	9.40
Partici -pation	15.40 (14.53)	3.04 (3.16)	16.40	3.76	17.06	3.55
Stress	25.57 (24.71)	6.56 (6.23)	25.13	7.52	12.73a 12.37b	

NB: The figures in parentheses are pre-implementation scores.

a = Male mean score of Banks et al (1980) population.

b = Female mean score of Banks et al (1980) population.

Table 7.5a **Comparison of the scores for respondent's views of the Job Characteristics-Mann Whitney U Test (P<.05)**

	Before (N=163) Implementation	After (N=127) Implementation		
	Mean Rank	Mean Rank	Z	P
Task significance	154.9	133.4	-2.19	.03

Job Characteristics and other variables

7.2.10 An examination of the links between the job characteristics and other variables revealed that for this sample there is a significant effect of age upon the amount of job variety and of the level of education on job feedback that respondents perceive they have in their work (see Table 7.5 b-c). There is no linearity of effect for age on job variety but the dichotomous educational groups found the higher qualified users considering that they have more feedback in their jobs.

7.2.11 The maximum variety is seen by those in the 40-49 year age group. The result could be due to the more experienced being given additional responsibilities from time to time but this possibility requires investigation. From the data obtained it is difficult to know why feedback should be a higher score for the higher educational levels. The reasons could be due to several factors which have not been explored such as the expectations of A level students encouraging more dialogue and responsiveness from managers.

Table 7.5b Job Variety broken down by age

Years	Mean	N	S.D.
Under 19	3.40	1	.00
20-29	3.33	63	.41
30-39	3.33	42	.31
40-49	3.57	18	.39
50-59	2.93	3	.31
Site Population	3.35	127	.38

Table 7.5c. Job Feedback broken down by educational level

	Low Qualifications (N=100) Mean Rank	High Qualifications (N=27) Mean Rank	Z	P
Feedback	59.1	82.2	-2.91	.004

Job Satisfaction and Participation scores

7.2.12 The job satisfaction, stress and participation scores are shown in Table 7.5 and 7.6, and the correlations for these three variables and the six job characteristics are shown in Table 7.7. The job satisfaction and participation scores are positively correlated with the majority of the job characteristics, whilst only two of the characteristics are significantly correlated with stress in a negative direction. There is no significant change between the two stages for both job satisfaction and stress. The same result is found if the scores of the respondents who completed the questionnaire at both stages are compared (see Table 7.6). In addition because of the differences in the work procedures and

differing use of the computer system a Mann-Whitney U Test comparison was also made between the pre and post-implementation scores for the two Sections independently but no significant result was found (P<.05). When the job satisfaction and participation scores were analysed by a one-way analysis of variance for any differences due to age, the only significant finding was that the older age groups had greater job satisfaction (Table 7.8). The significant increase in the participation score (Table 7.6) may be due to other factors which could have contributed to the change. For instance, the additional contact and interaction by the supervisors during training, or managers showing more interest due to "keeping an eye" on how the new system is settling in.

Table 7.6. Scores for respondents Attitude measures

	Before Go-Live		After Go-Live				
	Mean (N=164)	SD	Mean (N=127)	SD	df	T	P
Stress	24.71	6.23	25.57	6.56	263.97	-1.14	NS
			(24.89)	(6.43)	(219.18)	(-.24)	NS
Partici-pation	14.53	3.12	15.4	3.04	275.60	-2.47	.05
			(15.77)	(2.96)	(234.71)	(-3.29)	.001
Job Satis-faction	59.74	10.03	59.57	10.41	266.0	.41	NS
			(59.77)	(10.23)	(220.62)	(-.03)	(NS)

NB: a. Maximum scores possible:
Stress= 60 Participation= 25
Job Satisfaction = 90

b. The figures in parenthesis are the statistical results of a comparison made between Stages 1 and 2 for those respondents completing the questionnaire on both occasions (N=106).

Table 7.7. Correlations among the Attitude variables and the Job Characteristics (N=127)

	Job Satisfaction	Participation	Stress
Variety	.31**	.16*	-.16
Autonomy	.25*	.46**	-.22
Feedback	.27*	.49**	-.16
Dealing with others	.13	.30**	-.09
Task significance	.33**	.35**	-.34**
Friendship	.11	.39**	-.24*

* P>.05 ** P>.01

Table 7.8 Job Satisfaction broken down by age (Post-Implementation)

Years	Mean	N	SD	
Under 19	52.00	1	.00	
20-29	56.92	63	10.31	F=2.92
30-39	61.12	41	10.33	P<.05
40-49	64.00	18	9.53	
50-59	68.67	3	2.31	
Whole population	59.54	126	10.44	

Use of the VDT and the Job Satisfaction, Participation and Stress Measures

7.2.13 The amount of interaction by this group of staff with the VDT in any one day varies considerably (see paragraph 7.2.7). The majority (58) who used the VDT worked for less than two hours a day and 42 between three and six hours. A

T-test (two-tailed) comparison was made between the scores for the higher user group (3 hours or more a day) and the lower user group (less than 3 hours a day). The only difference in the scores found to be statistically significant was for the winter temperatures of "too warm" and "too cold". This result is probably strongly influenced by the higher user group, all being located in the Payments Section, whose staff consider it a colder office than the Awards Section (see paragraph 7.2.23).

Views of the Computer System

7.2.14 Views of various aspects of the computer system show that a good proportion of the users find the messages clear (65.0%), commands are regarded as straightforward (73.0%), it is of assistance in their job (84.0%) and is easy to learn how to use it (79.0%) (Table 7.9). The percentage of users who find the messages clear and straightforward are lower than the responses from other sites, about 80% or higher. Bikson & Gutek (1983) found that the functionality of the system (the degree that the system is satisfactory to use as a work tool) plays an important part in contributing to business effectiveness. The scope for improving the screen dialogues appears to be present due to lower percentages on two items ("the system's messages", "obscure commands") and are worth investigating, as was found by Stewart (1980) when investigating five organisations in order to establish what aspects could be improved. It was only a minority who find that they have some difficulty in learning to use the system. It may be of some value in trying to find out whether this is so, in order that some remedial action

can be taken, either to ascertain how the training can be amended to help this type of user in future, or to give some additional training if the system is not fully understood after being used. About a third of the users find the system requires a good deal of concentration, which is in contrast to the high percentage of respondents who find the system clear, straightforward and of definite assistance to them.

Table 7.9. Respondent's views of the computer system (The percentage of respondents who "agree" or "agree strongly" with each item)(N=100).

	%
The systems messages are easy to understand	65.0
The replies given by the system are very "businesslike"	56.0
Using the system requires a lot of concentration	31.0
The commands are all straightforward to use	73.0
I have considerable difficulty learning to use the system	8.0
The system does not provide me with the correct help	19.0
I had no difficulty learning to use the system	79.0
Some of the commands are rather obscure	20.0
The system is very tiring to use	16.0
The system is a real assistance to my work	84.0

7.2.15 Table 7.10 shows features of the VDT screen and keyboard which are regarded as unsatisfactory. There are clearly major concerns about the breakdowns which are experienced, 76.0% reporting this as a problem. The servicing is regarded as unsatisfactory by 27.0%. This could be a

reflection of the real situation with regard to the service provided or the response could be influenced by the amount of disruptions experienced.

Table 7.10. Problems of the visual display terminal (The percentage of respondents reporting "Often" to "Always") (N=100)

	%
Flickering of the screen	4.0
Brightness of the screen	19.0
Contrast of the screen	21.0
Distance to the screen	10.0
Angle of the screen	20.0
The paper documents are not always clearly legible	19.0
The characters on the screen are not clearly recognisable	6.0
Glare on the screen	29.0
The response time of the system afterkeying is not adequate	36.0
The servicing is not adequate	27.0
Distance to the keyboard	8.0
Angle of the keyboard	12.0
Breakdowns causing interruptions	76.0

7.2.16 The brightness, contrast and glare from the screen are of concern to a not insignificant minority, but the number of users reporting these difficulties is lower than other studies (Hultgren & Knave, 1974; Laubli et al, 1980; Dainoff, 1982; Rinalducci et al, 1983) which report between 30% and 60%. It is not known if the concern by 19.0% over the poor legibility of the documents is due to the design and layout

of the forms or the longhand entries which are illegible on the forms handled by the AOs.

Attitude Variables and the Computer System

7.2.17 A Mann-Whitney U Test of the VDT users' responses comparing the three variables, job satisfaction, participation and stress, with features of the screen and keyboard found only a few significantly related. The job satisfaction, participation, and stress scores were separated into high and low scoring groups. The low stress group find that the characters on the screen are clearer than the high stress group (Table 7.11a). The group with higher levels of job satisfaction are apparently less dissatisfied with the levels of servicing and also do not consider that there are as many breakdowns as the low satisfaction group (Table 7.11b). The amount of variance that the computer system variables contribute to the attitude variables is examined in the path model analysis described later.

Table 7.11a. Comparison of the scores for high and low stress groups on the features of the visual display terminal and computer system - Mann-Whitney U Test (P<.05)

	Low Stress Mean Rank (N=62)	High Stress Mean Rank (N=65)	Z	P
The characters are unclear	55.9	44.9	2.27	.03

Table 7.11b. **Comparison of the scores for the high and low job satisfaction groups on the visual display terminal and computer system - Mann Whitney U-Test (P<.05)**

	Low job satisfaction (N=40) Mean Rank	High job satisfaction (N=60) Mean Rank	Z	P
Servicing is inadequate	43.5	55.2	-2.13	.03
Breakdowns	58.4	45.3	-2.31	.02

7.2.18 The stress score may well show an increase for those who use the VDT for more than one hour without a break. This was tested but there was no significant relationship when the stress scores are broken down by the total hours spent on the VDT without a break. However this group of users are in the minority being only 7% of the total user population (Table 7.4c) as well as there being a possibility that these respondents are inaccurately reporting their use of the VDT.

Users Health

7.2.19 The questionnaire issued to the users, before and after using the VDTs, explored the level of symptoms users experienced and the degree of stress associated with work. Table 7.12 sets out the percentage of users expressing discomfort from "often" to "always" on a 19 item Health Symptom Inventory. In view of the items showing differences between the two stages (11 items an increase, 7 a decrease, 1 no change), a Mann-Whitney U Test (two tail) was made for each symptom between the first the

Table 7.12. Health Symptoms reported as attributable to the respondents work. (The percentage reporting "often" to "always")

	Before Go-live (N=164)	After Go-live (N=127)
	%	%
Eyestrain	34.1	27.6
Stiff Neck	25.6	27.6
Burning Eyes	15.2	18.9
Sore Shoulders	16.5	25.7
Back pain	17.1	28.1
Irritated eyes	14.4	20.5
Blurred vision	15.2	17.9
Stiff arms	5.5	3.1
Stiff legs	9.1	8.7
Neck pressure	15.9	6.5
Skin rash	3.0	3.9
Stomach pains	-	0.8
Swollen joints	0.6	3.9
Hand cramps	8.5	7.9
Sore wrists	4.3	3.9
Changed colour vision	0.6	1.6
Fainting	-	-
Loss in fingers	1.2	0.8
Headaches	35.4	39.4

questionnaire. This found stomach pains (mean scores 1.15 and 1.25, Stage 1 and 2 respectively; Z=-2.13, p=.03) was the only symptom which was statistically significant. This result can, however, be discounted because there was only a single

person reporting this symptom who did not complete a questionnaire at both stages.

7.2.20 The comparison with three other sites in DHSS (RD, OCAO, and Child Benefit Centre) shows a higher level of reported complaints than OCAO and RD, but not as high as CHBC. This difference could well relate to the fact that all the respondents at OG and CHBC are in the clerical grades, who report higher levels of stress, whereas the greater number of respondents at the other sites are in the higher grades. Also Bradley (1983) found that women report more symptoms than men, so a Mann-Whitney U Test was conducted to see if there was any gender differences in the response to the health symptoms at this site. Table 7.12a shows the only symptoms where there was a gender difference in the level of reporting. There also appears to be only a small effect in the level of influence of the job satisfaction scores when high and low job satisfaction groups were compared; two symptoms were showing a significant difference between the groups (Tables 7.12b).

7.2.21 Table 7.13 gives the percentages for comparison of the other three sites on the Health Symptom Inventory. There has been no analysis of the actual sick leave records to see if any relationship existed with the reports of ill-health symptoms in order to see if there was a similar trend for absenteeism.

Table 7.12a. Comparison of the scores by gender on the Health Symptoms - Mann-Whitney U Test (P<.05)

	Female (N=89) Mean Rank	Male (N=38) Mean Rank	Z	P
Swollen joints	67.1	56.7	-2.26	.02
Headaches	69.2	51.8	-2.60	.01

Table 7.12b. Comparison of the scores for the high and low job satisfaction groups on the health symptoms - Mann-Whitney U Test (P<.05)

	Low job satisfaction (N=51) Mean Rank	High job satisfaction (N=76) Mean Rank	Z	P
Back pain	72.4	58.4	-2.27	.02
Irritated eyes	72.2	58.5	-2.19	.03

7.2.22 The mean scores for the respondents on the GHQ 12 measure(stress) are shown in Tables 7.5 and 7.6. The minor increase in the mean score from 24.71 to 25.57 (the maximum score would be 60) is not statistically significant. The overall mean scores for the other three DHSS sites (excluding Overseas Group) are also shown in Table 7.5. The stress scores were dichotomised into high and low scoring groups and the two groups compared on the health symptom responses. The high stress group scored significantly higher (P<.05) on three items as shown in Table 7.13a.

Table 7.13. **The percentage of respondents stating "often" to "always" for the Health Symptoms Inventory (Stage 1)**

Health Symptom	OCAO	RD	Overseas Group	CHBC
Eyestrain	20.6	20.0	34.1	52.2
Stiff neck	2.9	11.9	25.6	59.3
Burning eyes	5.8	5.3	15.2	19.4
Sore shoulders	-	9.3	16.5	41.8
Back pain	8.8	12.0	17.1	49.3
Irritated eyes	8.8	10.7	24.4	25.4
Blurred vision	5.8	5.4	15.1	19.4
Stiff arms	2.9	1.3	5.5	13.4
Stiff legs	-	2.6	9.1	14.9
Neck pressure	-	8.0	15.9	40.3
Skin rash		1.3	3.0	6.0
Stomach pains	2.9	1.3	-	4.5
Swollen joints	-	2.7	0.6	7.5
Hand cramps	-	2.7	8.5	13.5
Sore wrists	-	-	4.3	9.0
Changed colour vision	-	-	0.6	1.5
Fainting	-	-	-	1.5
Feeling loss in fingers	2.9	-	1.2	-
Headaches	11.7	12.0	5.4	49.3

Table 7.13a. Comparison of the scores for the high and low stress groups on the health symptoms - Mann-Whitney U Test (P<.05)

	Low Stress (N=62)	High Stress (N=65)		
	Mean Rank	Mean Rank	Z	P
Irritated eyes	57.8	69.9	-1.98	.05
Skin rash	56.5	71.2	-3.49	.0005
Headaches	54.2	73.4	-3.13	.002

The Comparison of Results Between Awards and Payments Sections

7.2.23 Analysis was conducted on the data for any differences in the mean scores between the respondents using the VDTs in the two sections, Awards and Payments. The majority of the differences are related to the views expressed about the office environment. The Awards Section see their office as colder, draughtier and having more variable temperatures in both winter and summer months (Table 7.14), which is probably a reflection of the older and poorer quality accommodation.

7.2.24 Staff in the Awards Section consider that the office is quieter than those in the Payments Section at the post-implementation stage (Table 7.14). The differences found between the two sections on the health symptoms indicate only two which show a significantly different score - stiff legs and changed colour vision. The percentage of users suffering from the former symptom (9.1%) is quite high compared to two of the other three sites surveyed, but the latter symptom is only reported by 0.6% of the whole site. It would probably be advisable for them to seek professional

advice from an optician. It is unlikely that this can be attributed to the lighting differences because respondents do not have any significant differences in their reactions to the artificial lighting in the two sections.

7.2.25 There appears to be no influence upon the stress, job satisfaction and participation scores by the environmental differences because there is no significant difference between the two Sections at either stage on these variables.

Table 7.14. Items where there is a significant difference (Mann-Whitney U Test, 2 tailed) between the respondents in the two sections at Overseas Group at the post-implementation stage

	Awards (N=60)	Payments (N=66)		
	Mean Rank	Mean Rank	Z	P
Winter:Office Environment				
It is too warm	46.3	79.1	-5.33	.0000
It is too cold	75.5	52.6	-3.81	.0001
The temperature varies throughout the day	72.7	55.2	-2.89	.004
There are uncomfortable draughts	74.1	53.9	-3.24	.001
Summer:Office Environment				
It is too warm	56.1	70.2	-2.25	.02
The temperature remains constant throughout the day	54.6	71.6	-2.76	.006
The temperature varies throughout the day	71.8	56.0	-2.63	.009

Table 14 (cont)	Awards (N=60)	Payments (N=66)		
	Mean Rank	Mean Rank	Z	P
It is too quiet	69.4	58.2	-2.15	.03
Stiff legs	70.3	58.4	-2.26	.02
Changed colour vision	67.4	61.0	-2.32	.02

7.3 DISCUSSION

7.3.1 The users at this site are all administrative officers (AO) doing two main tasks, the award and payment of retirement pensions to claimants living abroad. The VDTs have been introduced to improve the efficiency of the processing of the pension claims. The amount the VDT is used in the working day varies considerably from a group of 27 people who do not use it at all, to a small number who use it more than four hours a day. The majority of the respondents using it between 1/2 hour and 4 hours a day. The changes in the job procedures due to the introduction of the VDTs have been more fundamental for those in the Payments Section.

7.3.2 The effects of the introduction of the VDTs had upon the job characteristics scores were only small, and none attained statistical significance, between the pre and post-implementation stages. Diagram 7.4 shows four of the six characteristics improving their scores marginally. When compared to the mean scores of three other DHSS sites five of the characteristics at the post-implementation stage are higher.

7.3.3 The introduction of the VDT has however been generally seen as of assistance to their work (84%). The system has not been difficult to learn for the majority of users. Even though a good majority saw the commands as straightforward and the messages clear, there were a greater number of respondents at other sites who considered these aspects of the system's performance of a more satisfactory nature; between 80-86%. There may well be a relationship between these slightly lower percentages and the fact that a number of respondents have had some difficulty in learning to use the system. It may be worthwhile exploring the reasons for the difficulties in learning and whether they are affected by the screen dialogues.

7.3.4 Despite the favourable reaction to the VDTs and the system there was no improvement in the job satisfaction or stress scores following the implementation of the on-line computer system. Possibly, this can be partially accounted for by the circumstances surrounding the postponed implementation date and the relatively close proximity to the date Stage 2 questionnaires were completed. Times of major changes are anxiety provoking at the best of times (Burrows et al, 1977; Beehr and Newman, 1978) and if expectations have been thwarted by problems delaying the "go-live" date it is not unexpected to see this influencing the way the job is viewed and could have offset initially the benefits the respondents felt in having the VDTs.

7.3.5 The level of participation did improve significantly for these users during the period of the enquiry, a finding which is somewhat surprising in view of the limited

representative involvement the users had with the design and change process. The Hawthorne effect of greater contact with managers during the change may have played a part in the improvement in the score. It was also noticeable that their scores on participation were below the other DHSS sites. The case for greater involvement within an organisation particularly at the time of major change was clearly demonstrated by Matherley and Matherley (1985) who found that participation was able to assist users in understanding the reasons for making the change and prepare for implementation of the change.

7.3.6 The incidence of breakdowns is clearly of a serious nature. Not only did a large percentage of users consider it a problem in answer to the specific item in the questionnaire but it also merited comment from many users in the open questions in the questionnaire inviting comments on the system. The level of difficulty may not only be the result of the actual number of breakdowns, but the position could be exacerbated in their eyes by the lack of immediate assistance which is regarded as unsatisfactory by a quarter of the users. Without having made enquiries into this issue fuller investigations require to be taken and solutions found.

7.3.7 Despite the health symptoms having only one item (stomach pains) which were changed significantly between the two stages it is a matter for concern that the overall level of symptoms being reported are higher than two other DHSS sites. These levels of discomfort and ill-health are similar to some reports for other traditional office workers but

higher than others (Donoghue, 1983; Laubli and Grandjean, 1984; Sundstrom, 1986, Grandjean, 1987), which appears to be a feature of the variation across employers and different sites as well as the actual nature of the work. This is not as adverse as found in some studies. Other researchers (Stewart, 1980; Cane et al, 1984; Lindstrom and Vuori, 1984; Hedge, 1986; Sundstrom, 1986; Wineman, 1986) have found between 45%-55% were distracted or interrupted in their work by telephones or conversation compared with 18.3% at OG. Hedge (1982) found office machines in open plan rooms of a local government office were a disturbance for 34% compared to 2.4% in this sample at Stage 2.

7.3.9 The lighting levels are satisfactory for approximately 56% (48.0% at Stage 1) so could be improved for just under half of the respondents, with approximately a third of them finding that reflections and glare are a problem. No measurements were made of the lighting levels in working areas for this study so it is not known whether the lighting levels are within the recommended bands for clerical and VDT work (250-500 lux) (eg Cakir et al, 1980; Boyce, 1981a). One of the problems for a mixed job environment is that the levels recommended for VDT and traditional clerical work are different, besides the needs of individuals also differing. One possible solution is to have subsidiary lighting available under the control of staff at individual work places. This form of control is a small but important contribution to the control that can be given to the individual worker (Hedge, 1982; Wineman, 1986). This can make an important contribution to employees establishing a degree of control over their working environment. It is frequently

found in stress research that a lack of control is a prime source of stressful feelings at work (Thompson, 1981; Greenberger et al, 1989). Examination of the lighting levels may also contribute to reducing the high levels of reported eyestrain at this site; 34% at OG compared with 20% at OCAO and RD (Table 7.13).

7.3.10 The dissatisfaction with the office climatic conditions is a significant problem. It is a major problem for the satisfactory management of office climates that there is such a wide range of views about the desirable temperatures, humidity and air movement. The lack of office environmental comfort has been found to be a major dissatisfaction for other populations (Sundstrom, 1986). Any improvements that can be achieved in employee's perceptions about the office environment would probably reduce both the general level of dissatisfaction and feelings of stress. It is not possible, of course, to achieve maximum benefits for everyone but aiming for an optimum level of acceptance could pay dividends. In a study by Nemecek and Grandjean (1973) (cited by Sundstrom, 1986) when the largest portion of workers were comfortable at 22 C there were others who were too hot or two cold.

7.3.11

Finally, the findings indicate that the office worker at OG prior to the arrival of the on-line VDTs had to contend with annoyance and dissatisfaction which may well contribute to increased levels of stress and ill-health. With the introduction of the computer system there was found to be little change in the levels of job satisfaction and stress.

However the functionality of the system was appreciated and with an improvement in the system's performance could contribute more significantly towards improvements in the staff's attitudes to their jobs.

Summary

7.3.12 As with the previous site there were considerable levels of dissatisfaction with the office environment and the building specific differences between the two groups of staff within the OG emerged. There was no change in the respondents level of satisfaction with the office environment between the two stages of the survey.

7.3.13 Due to the low functionality of the computer system for the Awards section only a handful of the staff used the VDTs.In the payments section the use varied but the majority used it for less than two hours a day.

7.3.14 There was no change in the JCI scores for the respondents who completed the questionnaire at both the stages. The participation score increased but the job satisfaction and stress scores did not. A comparison of the high and low VDT user groups found no differences in the JCI or attitude measures.

7.3.15 At this site, as at CHBC, breakdowns of the computer system were a major concern to a majority of the users. A comparison of the health symptoms reported at both stages also found no differences.

Diagram 7.1

Age Distribution

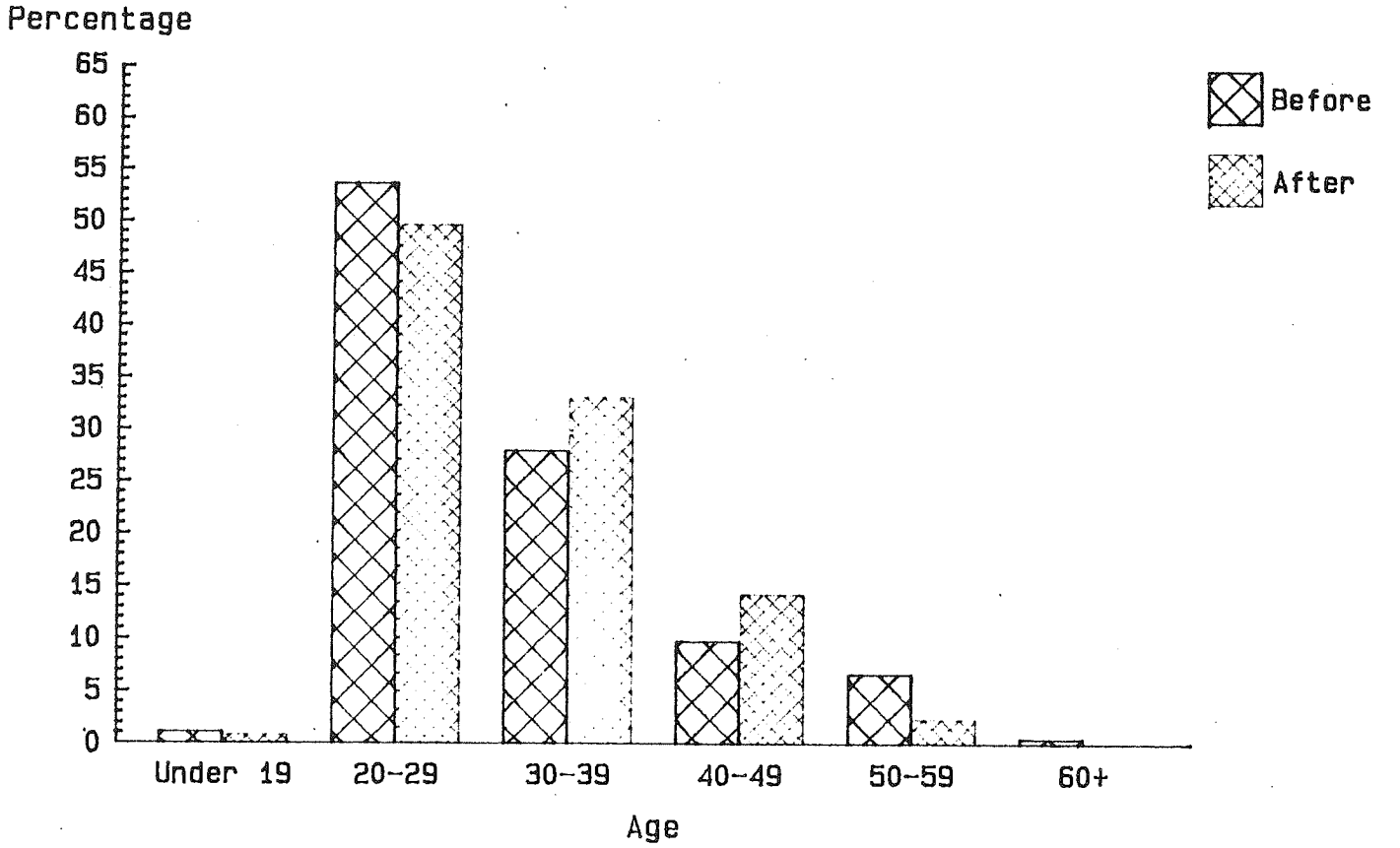


Diagram 7.2

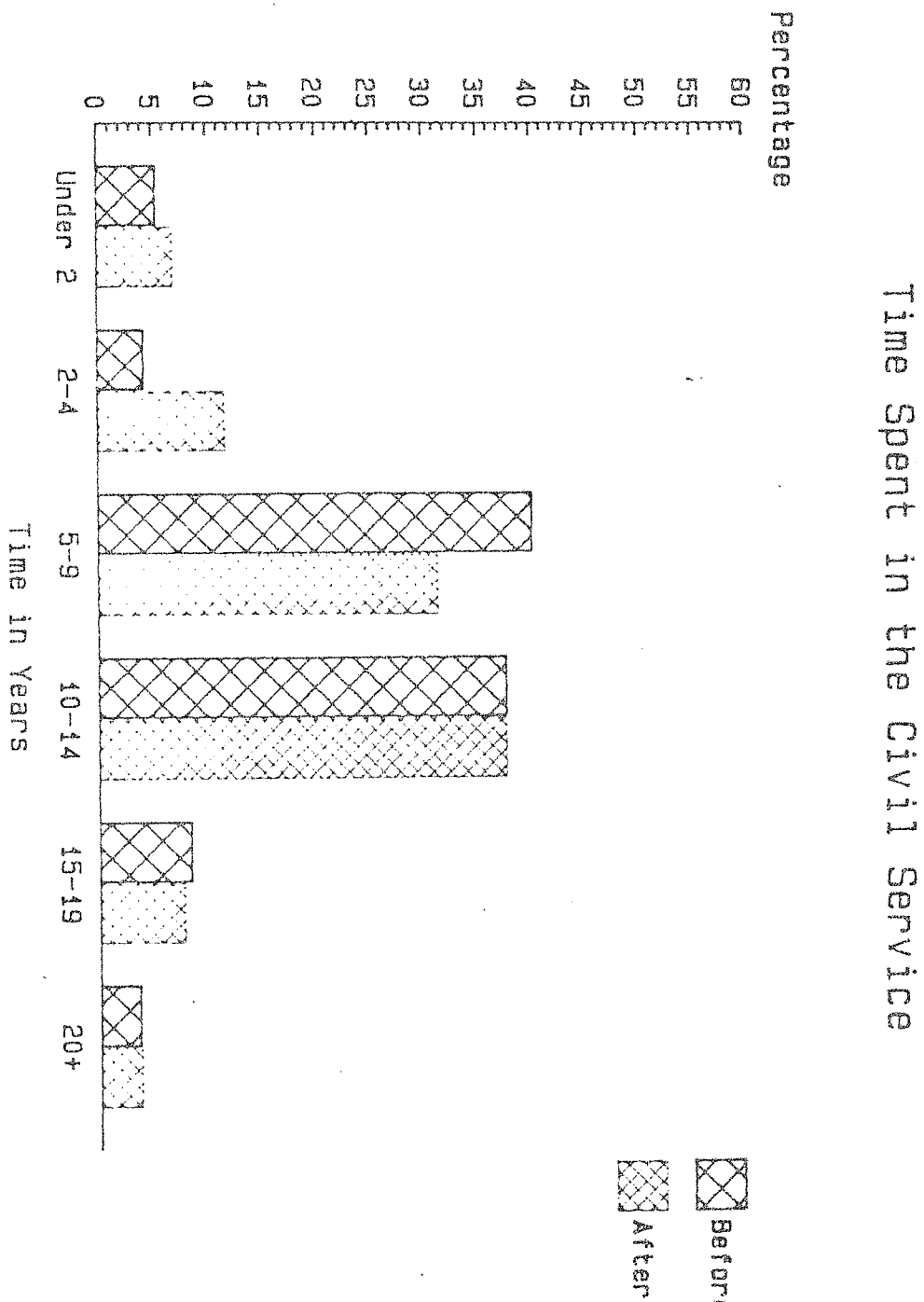

Time Spent in the Civil Service
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
Under 2
2-4
5-9
10-14
15-19
20+
Time in Years
Before
After

Diagram 7.3

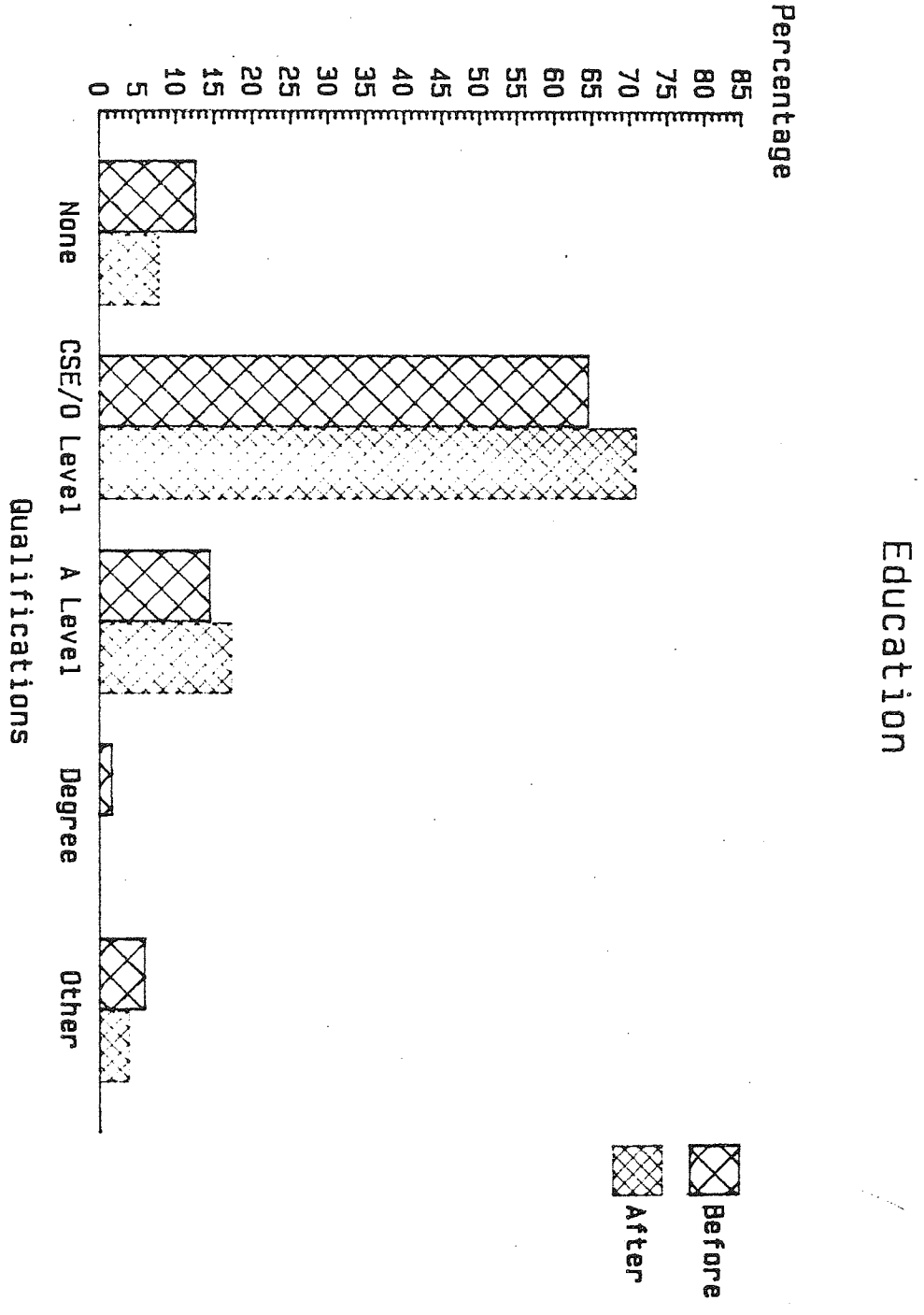
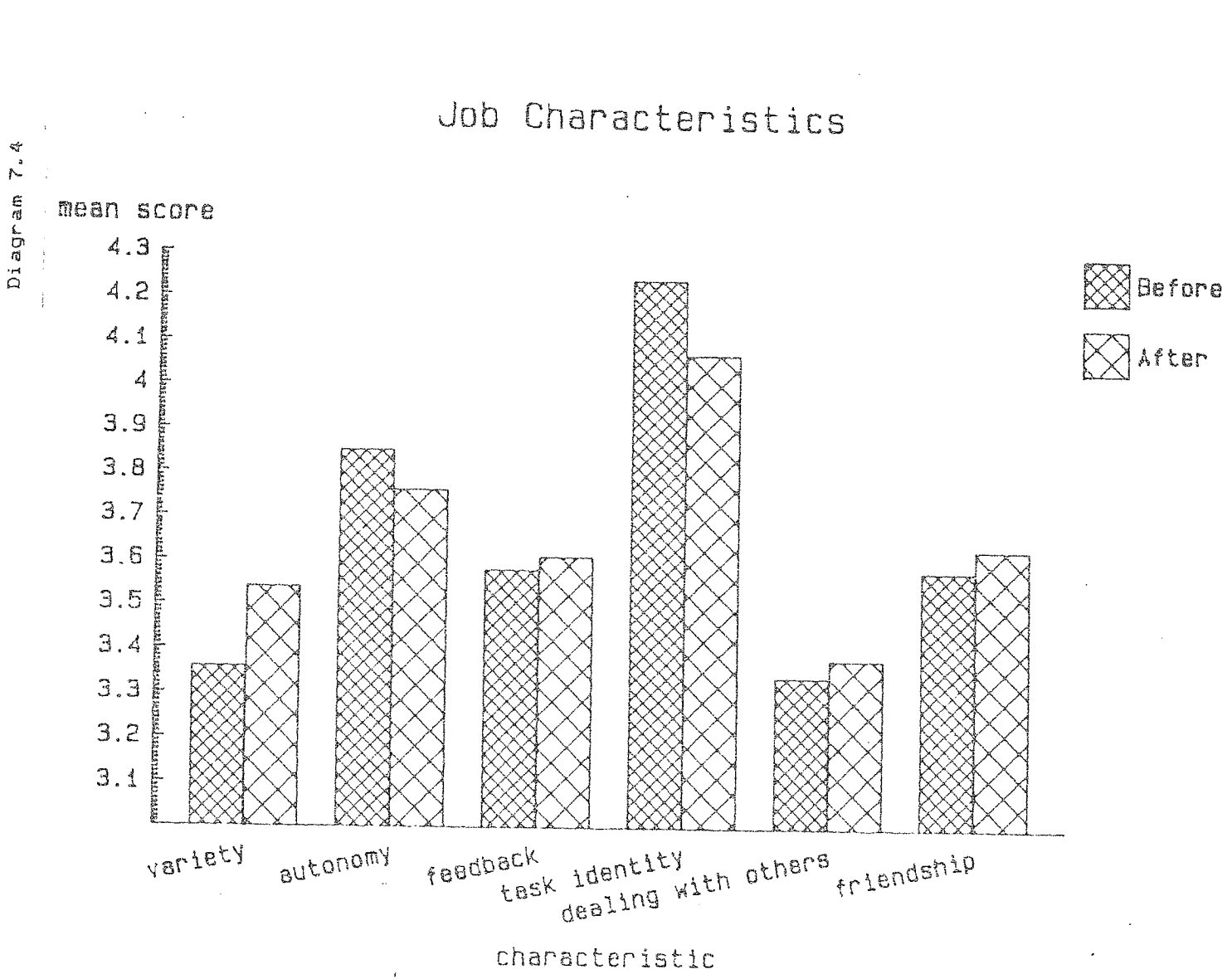

Education
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
None
CSE/O Level
A Level
Degree
Other
Qualifications
Before
After

Diagram 7.4



8. THE OFFICE OF THE CHIEF ADJUDICATIONS OFFICER IN SOUTHAMPTON

Chapter Summary

The background to the introduction of the office support system into OCAO is outlined. The detailed findings of the survey for the site are given and the relationships between the variables are explored. The impact of the use of the VDTs on the managers and staff are discussed.

8.1 BACKGROUND

8.1.1 This case concerns the data obtained from the managers and staff using th new office electronic support system in the Chief Adjudication Officers Office (OCAO) in Southampton. The work of OCAO is performed under the provisions of the Social Security legislation which set up a unified system of lay persons (as opposed to legally qualified) for determining questions as to the right to Social Security benefits. Adjudication Officers (AOs) are appointed at local Social Security offices who handle the majority of the adjudication work. Cases under rights of appeal against AO's decisions can be submitted to Social Security Appeal tribunals which have, in common with AOs, jurisdiction to determine questions as to the right to benefits under the Social Security schemes. OCAO monitors this lay work and deals with cases submitted to the Social Security Commissioners.

The Chief Adjudications Officer's Office

8.1.2 The principal functions of the CAO are:-

a) advise AOs in the performance of their functions,

b) keeps under review the system of adjudication and the operating standards of that system,

c) make written observations on claimant's appeals to the Social Security Commissioner's from decisions of the Social Security Appeal Tribunals,

d) determine the line to be taken where claimants challenge decisions of the Commissioners in the courts by way of appeal.

The Chief Adjudicating Officer's (CAO) supporting staff are located in Southampton. The CAO with 2 support staff are in a separate location in London. There is a total of 105 staff in the office.

The OCAO Office Support System

8.1.3 In January 1985, in order to assist in meeting the CAOs statutory requirements within existing manpower constraints, and with a growing workload, it was decided to introduce an automated office support system into the Southampton office. The preliminary business study identified the following functions would assist the office:-

- word processing
- electronic mail/messaging
- diary
- database
- spreadsheet
- graphics

The system was expected to meet business efficiency objectives of the CAO's office and also act as one of a number of pilot projects for the Departments Office Support System strategy.

8.1.4 The CAO's office dealt with 3000 cases submitted to the Commissioners and approximately 10,000 requests for guidance from AOs in 1985. Speedier production of text, in particular, was seen as a major contribution of the Office Support System. It was decided to introduce the Office Support System's VDTs into two of the six sections in the office dealing with advice and submission cases, the typing pool, general administrative support section, and the CAO and his two support staff at a separate location in London.

8.1.5 Thirty intelligent VDTs and ten printers were installed in December 1986. The system is based on Northern Telecom's (now part of the ICL PLC group of companies) Vienna Office which runs under the Xenix operating system. The system runs on three shared resource computers (SRC) located in a dedicated air conditioned room separate from the users. The printers are a mixture of dot-matrix and laser, the former having acoustic hoods. The printers are located in the users work rooms.

8.1.6 Initially there were problems with the reliability of the SRCs but within 2 months the problems had been rectified. Throughout the first 12 months of use several problems with circuit boards in the VDTs occurred, averaging one a week. Acceptance trials of the system were completed in January 1987 and the "go live" date was 7th January 1987.

OCAO Training

8.1.7 The Training was seen as an essential and important contribution to the successful implementation of the Office Support System. The whole of the staff, users and non-users,

were given a 2½ hour "awareness" training course in December 1986 which dealt with:

- the organisation's general aims regarding computerisation,
- the features and expected benefits of the Vienna System,
- details of the new technology agreement reached with the trade unions,
- ergonomic, health and safety information,
- the skills training programme,
- the progress of the installation plans.

The users of the system were given two skills training courses; a basic skills course in January 1987 and a consolidation/advanced course in March 1987.

8.1.8 The skills training on the use of the VDT, and the Vienna System, was aimed to provide the in-house Systems Manager and his team with sufficient working knowledge in order to contribute to the effective use of the system by the users; likewise for the users to use the system as a beneficial contribution to their daily tasks and to contribute to the growth of the system.

8.1.9 The hardware supplier undertook the initial and consolidation training, but continued support for the users came from the Systems Manager and for two months after the go-live date by a Departmental trainer. The training took place on site in a dedicated room with six VDTs and a printer.

8.1.10 The emphasis of the basic training was on the

straight forward use of the word processing package. Additional consolidation training was given to all the users on the word-processing and electronic mail software in addition to a limited number who requested training on the data-base and spreadsheet facilities. Detailed user manuals were provided by the equipment supplier.

The OCAO Office Environment

8.1.11 The Office of the Chief Adjudicating Officer is located in Southampton. The majority of staff are housed on three floors in Cumberland House which is a modern office block built in 1974. The OCAO has occupied the building since April 1975. The building is a good quality modern office block with pleasant architectural fittings. The majority of the accommodation is divided into small rooms which generally have satisfactory natural light from the windows with occupancy varying from one to nine people. A number of minor internal alterations were made to accommodate the computer installation.

8.1.12 The central heating is by water radiators in casings located under the windows with fan-assisted air circulation. Thermostats control each radiator grille and its associated fan. The office lighting appears bright and adequate for normal office purposes. Plastic diffusers are fitted to the fluorescent lighting tubes which had been changed to "natural cool tubes". Vertical blinds were fitted to the windows in VDT rooms.

8.1.13 The furniture requirements of the users were taken into account and additional equipment purchased prior to the

VDTs being received. The desks, however, were not specifically designed for VDT use, so there was no desk cable management which allowed loose wiring to run under the desk.

8.1.14 Eyesight testing had not been arranged on site for users. They had however been encouraged to visit an optician for a test where this was considered appropriate. The Department had arranged for payment of any expenses incurred up to a maximum allowance. It is not known how many have had an eye test because there was no requirement for a member of staff to report having undergone a test, and details of actual claims made are not readily identifiable.

8.2 SURVEY RESULTS

8.2.1 The biographical information of the respondents is shown in diagram 8.1-8.3 (see pages 225-228). At the Stage 1 completion there were 18 (52.9%) female and 16 (47.1%) male respondents and at the Stage 2 completion 15 (45.5%) female and 18 (54.5%) male respondents. 75.8% (61.8%) wore glasses and 12.1% (8.8%) wore contact lenses (the figures in parenthesis are for stage 2)

8.2.2 The questionnaire data of the main survey was supplemented at this site by an interview programme, both before and after the "go live" date, with the users, project manager and the computer suppliers representative. There is also, as part of this additional evaluation programme commissioned by the DSS a second post-implementation

questionnaire (See Appendix 1d). Some reference is made in this case study to data from these sources.

Office Environment

Room Atmosphere

8.2.3 As was found at the two former sites the respondents reactions to the office environment were varied in their degree of satisfaction of the parameters considered (ambient temperature, light and noise - see table 8.1). There were marginally a smaller percentage at this site, however, who

Table 8.1. View of office environment (Reporting "Very Often" or "Always")

	Stage 1		Stage 2	
	Winter	Summer	Winter	Summer
	%	%	%	%
Too Warm	19.5	58.8	12.1	12.1
Comfortable Temperature	7.3	10.3	39.4	42.5
Too Cold	17.6	1.5	-	3.0
Temperature Varies	26.5	14.7	18.2	9.1
Temperature Constant	14.8	23.6	30.3	27.2
No Air Movement	54.4	55.2	39.4	24.3
Draughts	16.2	8.8	9.1	-
Satisfactory Ventilation	8.8	11.8	42.4	36.4

found the temperatures comfortable; 39.4% considered that they "very often" found the temperatures comfortable during the winter and 42.5% during the summer; those satisfied rises to 90.3% (winter) and 80.6% (summer) when the number

who responded "often" or more are included. There are sizeable minorities, however, reporting that they find the temperature varies too much (18.2% Winter), there is insufficient air movement (39.4% Winter, 24.3% Summer), and that it is too warm (12.1% Winter and Summer). On the whole at post-implementation stage, there is minor improvement on most of the items from the level found before the system was installed. This however is not statistically significant if all the scores of the respondents are taken into account.

Lighting

8.2.4 There was no objective measurement made of the lighting levels. The lighting was regarded as satisfactory (see table 8.2) by 90.3% who "often" felt satisfied at the Stage 2 questionnaire completion. Only relatively smaller percentages thought that reflections, glare or too much light troubled them. When comparing the scores of the two Stages on the lighting questions, there was only one item ("lighting is satisfactory") which was found to be statistically significant (Table 8.2a).

Table 8.2. Views about the office lighting (Reporting "Often" to "Always")

	Stage 1 %	Stage 2 %
Adequate Daylight	66.7	64.5
Reflection/Glare Flicker	21.3	12.9
Too Bright	21.2	9.7
Satisfactory	60.6	90.3
Too Dull	6.1	-

Table 8.2a. Comparison of the scores of the lighting items - Mann-Whitney U Test (P<.05)

	Pre-Implementation (N=33)	Post Implementation (N=31)		
	Mean Rank	Mean Rank	Z	P
Lighting is adequate	28.2	37.1	-1.97	.05

Noise

8.2.5 The noise levels of telephones and conversation in the office were found too distracting for 25.8% at Stage 2, which was a considerable reduction in the number reporting such problems at Stage 1. No information was obtained as to the reason for this change. However the change in the mean scores on this item were not found to be statistically significant on the Mann-Whitney U Test. Internal noise problems was exceeded slightly by those who were distracted regularly by outside noise, approximately a third at both

Table 8.3. Views about the office noise levels (Reporting "Often" to "Always")

	Stage 1 %	Stage 2 %
Too Quiet	-	-
Too Distracting	46.9	25.8
Office Machine	2.9	6.1
Outside Noise	29.4	32.3

stages. This is probably because the building fronts onto a busy road and the windows are not double glazed. There is a

small increase in the number who reported being troubled by office machines (2.9% to 6.1%) but this is not at a statistically significant level.

Furniture

8.2.6 At this site the users received new desks and chairs just before Stage 1 questionnaires were issued. 96.8% were generally satisfied with their desk and 87.1% with the comfort of their chair at the post-implementation stage. There had been no significant change in these levels of satisfaction between the pre-implementation and post-implementation questionnaires.

Amount of VDT use

8.2.7 The amount of time spent by the users on the VDT was reported as less than one hour a day by just over half (51.4%)(Table 8.4a). 30.4% said that they were working on a VDT more than three hours a day. Twenty two (66.7%) said that they spent less than an hour at any one time on the VDT (tables 8.4c).

Table 8.4a. Time spent on average on the VDT in a day

Hours	N	%
Less than 1	17	51.4
1-2	6	18.2
3-4	5	15.2
5-6	3	9.1
More than 6	2	6.1

8.4b. Time spent on average on the VDT in a day broken down by job level

Count Row Per Cent	Less than 1 Hr	1-2 Hrs	3-4 Hrs	5-6 Hrs	More than 6 Hrs
Managerial	5 62.5	2 25.0	1 12.5		
Professional	9 64.3	3 21.4	1 7.1	1 7.1	
Clerical	3 100.0				
Secretarial/ Typist		1 12.5	3 37.5	2 25.0	2 25.0
Total No %	17 51.5	6 18.2	5 15.2	3 9.1	2 6.1

Table 8.4c. Maximum number of hours spent on the VDT without a break

Hours	N	%
Less than 1	22	66.7
1-2	6	18.2
3-4	4	12.1
More than 6	1	3.0

The breakdown of the use of the VDT by the job level is shown in table 8.4b. As one would expect the secretary/ typist group spend in total more time than the other levels working on the VDT. A greater amount of time spent by the managerial and professional grades on the VDT was using the word processing facility. 65.8% estimate that they use the word processing facility "frequently" or "more frequently" (Shaw 1988).

Job Design and User Job Satisfaction

8.2.8 The job characteristic scores obtained by the JCI measure are shown in diagram 8.4 (see end of chapter). On all the six characteristics the mean scores increased by Stage 2, but none of the differences were significant at the 0.5 level (table 8.7). The job satisfaction, stress and participation scores are shown in table 8.5 and the Pearson correlation co-efficients, for these three variables with the six job characteristics are at Table 8.5a for the post-implementation responses. There were only four of the characteristics positively correlated at a significant level with the participation scores, all the others being non-significant at the .05 level.

8.2.9 Table 8.5 sets out scores from other populations; a combined score from three DHSS sites (OCAO, CHBC, RD), and the original researchers findings for their respondents across a wide spectrum of white collar jobs. The combined DHSS sites are lower means than OCAO on three characteristics. This is probably due to the fact that the CHBC had only the administrative assistant grade as respondents, and it would be a reasonable expectation to find that most of these items would have lower scores, except for the stress item which would be higher.

8.2.10 An examination by Mann-Whitney U Test of the difference in scores, between the job characteristics and other variables, revealed that for this small sample there is a significant effect of gender on the amount of variety

Table 8.5. Comparisons of Mean Scores for the Job Characteristics and Attitude Measures

Variables	OCAO		Results of 3 DHSS sites (OCAO,CHBC,RD) after computers installed		Original Researchers	
	Mean	SD	Mean	SD	Mean	SD
Variety	3.33 (3.29)	.71 (.83)	3.11	.74	2.93	.90
Autonomy	3.86 (3.67)	.65 (.88)	3.84	.61	3.72	.83
Feedback	3.38 (3.22)	.55 (.77)	3.39	.63	3.03	1.05
Task Identity	3.88 (3.76)	.69 (.90)	3.76	.80	4.01	.95
Dealing with others	3.20 (3.16)	.69 (.71)	3.29	.72	4.14	.98
Friendship	3.32 (3.25)	.51 (.52)	3.54	.64	3.60	.96
Job satisfaction	62.58 (61.52)	12.66 (12.63)	56.94	13.35	63.80	9.4
Participation	18.03 (16.76)	3.24 (4.47)	16.40	3.76	17.06	3.55
Stress	23.06 (24.74)	7.06 (7.68)	25.13	7.52	12.73a 12.37b	

NB The figures in parentheses are pre-implementation scores

a = Male mean score of Banks et al (1980) population.
b = Female mean score of Banks et al (1980) population.

Table 8.5a. **Correlations among the Attitude variables and the Job Characteristics (Post-Implementation) (N=33)**

	Job Satisfaction	Participation	Stress
Variety	.39	.48*	-.28
Autonomy	.03	.49*	.05
Feedback	.08	.38	-.12
Dealing with others	.43	.59**	-.35
Task significance	.13	.48*	-.12
Friendship	-.04	.18	-.12

* P<.05 ** P<.01

and friendship that respondents perceive they have in their work (Tables 8.6). The males have a greater amount of variety, as do managers and specialist staff compared to the clerical, secretarial and typing staff (Tables 8.6b). Also the managers and specialist staff have a greater score for dealing with others than do the typing and clerical staff. A comparison of the mangers/professionals with the clerical/ typist grade found a significant difference for the different job levels on the amount of variety, autonomy and friendship found in their workplace (Tables 8.6). The education level obtained by respondents also influenced the amount of dealing with others and autonomy (Table 8.6), though it is likely to be confounded by the fact that the higher the educational attainment the job level is more likely to be higher. Table 8.6b shows that the degree and A level holders have attained the higher levels of responsibility in the organisation, whereas more of the

lower education achievers are in the clerical and secretarial/typing groups.

8.2.11 Even though there are only these few statistically significant results across the job levels, there is a clear picture of descending scores for most measures from the manager group to the secretarial/typist (Table 8.6b). The job characteristics measures examined the users perception of their job. A detailed task analysis was not undertaken of the users jobs because of the high level of intrusion this generates and the management did not wish this to happen. However a structured interview was conducted with all the users, which clearly established that job skills had changed or most people (Shaw 1988). The most obvious changes were the addition of keyboard skills (for non typists), the knowledge of the structure of the computer system, and the ability to design screen layouts. In the case of the in-house systems manager, additional skills relating to knowledge of small systems application and the structure of such systems. The users had generally adapted well to these new demands.

8.2.12 The job satisfaction and participation scores are shown in tables 8.5, and 8.7. There is no significant change between the Stage 1 and State 2 scores (T-Test, 2 tailed, a significant level of .05 was not reached), even though the trend is one of a small amount of improvement.

Table 8.6. Comparison of the Job Characteristics by gender, grade and educational level - Mann-Whitney U Test (P<.05)

	Female (N=15) Mean Rank	Male (N=18) Mean Rank	Z	P
Variety	11.5	21.5	-3.00	.003
Friendship	13.1	20.3	-2.13	.04

	Managerial /professional (N=) Mean rank	Clerical /typist (N=) Mean rank	Z	P
Variety	19.6	11.8	-2.21	.03
Autonomy	19.3	12.4	-1.96	.05
Friendship	20.7	9.6	-3.12	.002

	Low educational qualification Mean rank	High educational qualification Mean Rank	Z	P
Autonomy	12.1	20.2	-2.37	.02
Dealing with others	11.5	20.6	-2.67	.008

Table 8.6a. Breakdown of the job level by educational attainment

Count Row Pct	No Qualif -ication	CSE/'O' Level	'A' Level	Degree	Other
Managerial		1 12.5	4 50.0	3 37.5	
Professional	1 7.1	3 21.4	5 35.7	4 28.6	1 7.1
Clerical		3 100.0			
Typist/ Secretary	3 37.5	2 25.0			2 25.0
No Total %	4 12.1	9 27.3	10 30.3	7 21.2	3 9.1

Table 8.6b. Comparison of the mean scores for the Job Characteristics and Attitude measures across the job levels (Post-implementation)

	Managerial (N=8)		Specialist (N=14)		Clerical (N=3)		Secretarial /Typist (N=8)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Variety	3.90	.59	3.31	.66	2.93	1.14	2.92	.43
Autonomy	4.13	.38	3.98	.36	3.67	.17	3.44	1.10
Feedback	3.50	.48	3.47	.44	3.07	.12	3.23	.82
Task Identity	4.21	.45*	3.84	.59	3.83	.52	3.62	1.03
Dealing with others	3.75	.46	3.11	.62	2.58	.52	3.03	.80
Friendship	3.71	.38	3.41	.41	3.11	.25	2.85	.54
Job Satis-faction	65.13	7.32	58.29	16.05	58.33	10.02	69.13	8.43
Partici-pation	19.50	2.88	17.57	2.93	18.00	2.65	17.37	4.27
Stress	20.63	7.41	24.79	7.89	27.33	4.73	20.88	5.00

Table 8.7. Comparison of the Pre and Post Implementation scores for respondents Attitude measures

	Before Go-live Mean (N=33)	SD	After Go live Mean (N=31)	SD	df	T
Stress	24.74	7.68	23.06	7.06	64.81	.93
Partici-pation	16.77	4.47*	18.03	3.24	60.15	-1.33
Job satisfaction	61.52	12.63	62.58	12.66	64.00	-0.34

NB Maximum scores possible: Stress= 60 Participation= 25
Job satisfaction= 90

Features of the Visual Display Terminal and the Job Satisfaction, Participation and Stress Measures.

Amount of VDT use

8.2.13 The amount of interaction by this group of staff with the VDT in any one day varies considerably (see paragraph 8.2.7). The majority (23) who use the VDT worked for less than two hours a day and 10 between three and six hours. A comparison was made between the scores for the higher user group (3 hours or more a day) and the lower user group (less than 3 hours a day). The only differences in the scores found to be statistically significant are shown in table 8.8.

Table 8.8. Items where there is a significant difference (P<.05) between the high users (3 hours or more a day) and the low users (less than 3 hours a day). (Student T-test, two tailed)

	Low users (N=23)		High users (N=10)			
	Mean	SD	Mean	SD	df	T
Age	3.47	.95	4.40	1.08	15.38	-2.34
Job Level	1.91	.79	3.30	1.16	12.81	-3.45**
No air movement in winter	3.14	1.32	2.20	1.03	22.28	2.17
No air movement in summer	2.95	1.24	2.00	.82	25.74	2.54
Too cold	1.91	.77	1.40	.52	25.32	2.16
Adequate daylight	2.81	1.60	4.20	.92	27.74	-3.06**

** P<.01

Views of the Computer System

8.2.14 Overall views about the system were favourable for approximately half of the users; 51.5% finding it of "real assistance" in their work (table 8.9). The same number also thought that they had not had difficulty in learning to use the system. The messages on the system were satisfactory for a large number (87.9%), the commands were also straightforward to use (69.7%) and 60.6% found the replies were businesslike. Almost half, however, found they required "a lot of concentration" (48.5%) and 24.2% didn't think they were provided with the assistance they wanted from the computer. There is clearly scope for examining the command languages as 36.4% found them rather obscure and 11.2% had difficulty in learning to use the system.

8.2.15 Table 8.10 shows features of the VDT and keyboard which were regarded as unsatisfactory. The system response time is clearly of major concern, with 54.5% reporting it as a problem. The site kept detailed observations on the system response times at two stages during the first 12 months of use. The timings were taken at similar times during a five day working period in March 1987, soon after the machines were installed, and again in February 1988, in order to take account of the different loadings on the machines. A sample of the activities timed indicate that the mean times are generally at the higher end of the desirable range or well in excess of the target limit. Some of the mean times given below indicate the situation:-

Incorporate Page 1	4.58	2.95
Search and replace "any other/all others"	9.53	11.28
Spell check	19.68	16.25
Move a paragraph	3.84	4.33
Select and send mail	5.88	5.25

The computer manager and supplier were cognizant of this issue and expected that the impact of the upgrade on the central processors would improve the systems performance in this respect; a minimum of 20% was anticipated (Shaw 1988).

8.2.16 The breakdowns experienced by these users was considerably less than the other sites, and clearly, when breakdowns did occur they found the servicing adequate. This may well be due to the system being a trial for a small group of users, who had an on-site systems manager and an enthusiastic manufacturers service engineer, who attended call-outs very rapidly, whereas, CHBC and OG sites had very limited resources to call upon in a centralised ADP unit with a more remote manufacturers service backup. There were very few users reporting problems with glare or flicker on the screen (6.1% and 3.0% respectively), with much higher percentages at the other sites reporting other screen problems. Even though the clarity of the paper documents is not a major problem, 9.1% regarding it as a difficulty, there is insufficient information to establish whether this is due to poor long-hand entries or the design and layout.

Table 8.9. Respondents views of the computer system (The percentage of respondents who "agree" or "agree strongly" with each item), (N=33)

	%
The systems messages are easy to understand	87.9
The replies given by the system are very "businesslike"	60.6
Using the system requires a lot of concentration	48.5
The commands are all straightforward to use	69.7
I had considerable difficulty learning to use the system	11.2
The system does not provide me with the correct help	24.2
I had no difficulty learning to use the system	51.5
Some of the commands are rather obscure	36.4
The system is very tiring to use	9.1
The system is a real assistance to my work	51.5

Further enquiries would be required to investigate the underlying causes.

8.2.17 A Mann-Whitney U Test comparing the dichotomised stress and job satisfaction groups' responses to the features of the system found a few significantly related. The high job satisfaction respondents perceive the "system being of real assistance" and the system "replies being business-like" (Table 8.11). There is also a significant difference between the stress groups on the two items

Table 8.10. **Problems of the visual display terminal (The percentage of respondents reporting "Often" to "Always") (N=33)**

	%
Flickering of the screen	3.0
Brightness of the screen	-
Contrast of the screen	-
Distance to the screen	6.1
Angle of the screen	-
The paper documents are not always clearly legible	9.1
The characters on the screen are not clearly recognisable	-
Glare on the screen	6.1
The response time of the system after keying is not adequate	54.5
The servicing is not adequate	-
Distance to the keyboard	-
Angle of the keyboard	-
Breakdowns causing interruptions	9.1

Table 8.11. **Comparison of the scores for the dichotomised job satisfaction and stress groups on the computer system's attributes - Mann-Whitney U Test (P<.05)**

Job satisfaction	Low (N=11) Mean Rank	High (N=22) Mean Rank	Z	P
The system's replies are businesslike	12.4	19.3	-2.06	.04
The system is a real assistance to my work	11.73	19.6	-2.30	.03

Table 8.11 cont.

Stress	Low (N=21) Mean Rank	High (N=12) Mean Rank	Z	P
Brightness of the screen	21.7	8.8	-3.69	.0002
The angle of the screen	15.5	19.6	-2.37	.02

"Brightness" and "angle of the screen" (Table 8.11). The numbers who find that the brightness of the screen presents a problem are not indicating that it is a frequent problem (Table 8.10).

Users Health

8.2.18 The questionnaire issued to the users, before and after using the VDTs, explored the level of symptoms users experienced and the degree of stress associated with work. Table 8.13 sets out the percentage of users expressing discomfort from "often" to "always" on the 19 item Health Symptom Inventory. Despite several items showing clear differences (10 items an increase, 4 a decrease) a comparison of the scores (Mann-Whitney U Test) for each symptom, between the first and second completion of the questionnaire, show that none of the differences between the scores were statistically significant. The Health Symptom Inventory was also examined (Mann-Whitney U Test) for differences in the scores due to gender, education qualifications, and job level. The significant differences are shown in Tables 8.13a. There is probably a confounding factor of education on job level to have the difference on the "burning eyes" item appearing as significant in both comparisons. An examination of the stress and job

satisfaction dichotomised groups's, for different responses on the health symptoms, found a few items with significant differences (Tables 8.13b). The high stress group and the low job satisfaction group have higher scores on these items; both groups having "stiff legs" for which it is difficult to see a reason that one could attribute to using the VDT, unless this increases the amount of time spent seated at the desk and the additional immobility contributes to the change.

8.2.19 The comparison with three other sites in DHSS (Table 8.14) shows a lower level of reported complaints than the other sites. There has been no analysis of the actual sick leave records to see if any relationship existed with the reports of ill health symptoms.

8.2.20 The means scores on the GHQ12 for the respondents are shown in tables 8.5 and 8.7. Despite a small reduction in the means score (the maximum stress score will be 60) between the two Stages this is not statistically significant.

Table 8.13. **Health Symptoms reported as attributable to the respondents work. (The percentage reporting "often" to "always").**

	Before Go-live %	After Go-live %
Eyestrain	20.6	15.2
Burning eyes	5.8	3.0
Irritated eyes	8.8	12.1
Blurred vision	5.8	3.0
Changed colour vision	-	-
Stiff neck	2.9	12.1
Neck pressure	-	6.1
Sore shoulders	-	-
Stiff arms	2.9	3.0
Stiff legs	-	6.1
Swollen joints	-	-
Hand cramps	-	3.0
Sore wrists	-	-
Feeling loss in fingers	2.9	-
Back pain	8.8	9.1
Fainting	-	-
Skin rash	-	6.1
Stomach pains	2.9	6.1
Headaches	11.7	15.2

Table 8.13a. Comparison of the scores by gender, education, and job on the Health Symptoms - Mann-Whitney U Test (P<.05)

	Mean Rank	Mean Rank	Z	P
Gender	Female (N=15)	Male (N=18)		
Sore wrists	19.4	15.0	-2.3	.03
Educational qualification	Low (N=13)	High (N=20)		
Burning eyes	20.6	14.7	-1.96	.05
Job level	Professionals/ Managers (N=22)	Clerical/Typist (N=11)		
Burning eyes	14.9	21.1	-1.99	.05
Sore shoulders	14.8	21.5	-2.45	.02
Swollen joints	16.0	19.0	-2.03	.04

Table 8.13b. Comparison of the scores for the dichotomised job satisfaction and stress groups on the Health Symptoms - Mann-Whitney U Test (P<.05)

	Mean Rank	Mean Rank	Z	P
Stress	Low (N=21)	High (N=12)		
Burning eyes	14.1	22.1	-2.64	.009
Stiff legs	15.1	20.3	-2.05	.05
Stomach pains	15.5	19.6	-2.37	.02
Job Satisfaction	Low (N=11)	High (N=22)		
Stiff legs	20.9	15.1	-2.28	.03
Neck pressure	20.9	15.1	-2.04	.05

Table 8.14. **The percentage of respondents stating "often" to "always" for the Health Symptoms Inventory (Stage 1)**

Health Symptoms	CHBC	OG	OCAO	RD
Eyestrain	52.2	34.1	20.6	20.0
Stiff neck	59.3	25.6	2.9	11.9
Burning eyes	19.4	15.2	5.8	5.3
Sore shoulders	41.8	16.5	-	9.3
Back pain	49.3	17.1	8.8	12.0
Irritated eyes	25.4	24.4	8.8	10.74
Blurred vision	19.4	15.2	5.8	5.4
Stiff arms	13.4	5.5	2.9	1.3
Stiff legs	14.9	9.1	-	2.6
Neck pressure	40.3	15.9	-	8.0
Skin rash	6.0	3.0	-	1.3
Stomach pains	4.5	-	2.9	1.3
Swollen joints	7.5	0.6	-	2.7
Hand cramps	13.5	8.5	-	2.7
Sore wrists	9.0	4.3	-	-
Changed colour vision	1.5	0.6	-	-
Fainting	1.5	-	-	-
Feeling loss in fingers	-	1.2	2.9	-
Headaches	49.3	5.4	11.7	12.0

8.3 DISCUSSION

8.3.1 The office support system at this site was being trialed by users at different levels in the organisation and for different purposes; some were using only the word-processing package, whilst others were using spreadsheet and

database applications as well. The amount that the VDT is used in the working day varies considerably, the majority of the respondents using it between half an hour and two hours a day. The scores on the JCI following the introduction of the VDTs increased slightly at the post-implementation stage but none of these were at a statistically significant level. There were a number of job characteristics which were found to be related to the gender and education level of the users, namely variety, autonomy, dealing with others, and friendship. The absence of detailed task analysis doesn't allow for the formulation of any conclusions about how the computer system had altered basic tasks. There was, however, indications at the post-implementation interviews that changes in the word processing procedures had influenced the nature of text production, and the impact on sub-tasks was becoming apparent eg some authors composing direct onto the screen, typists spending less time re-typing large amounts of text in order to carry out amendments to the first word processed text. These changes reflected some of the features that Buchanan and Boddy (1982) found in their study of video typists. The professionals and managers were only beginning to find benefits emerging from the use of the database and spreadsheet applications (Shaw 1988). The indications were that it would be some time before there was any measurable impact upon the tasks of these job holders to the degree that was found by Bjorn-Anderson et al (1986) in their studies of manager-computer interaction.

8.3.2 The finding that no changes between the two stages occurred at this site on the JCI scores, raises the issue about how significant have the changes to be at the

individual task level before any influence on the JCI are found. Wall and Clegg (1981) found that job characteristics (measured by the JDS-Hackman and Oldham, 1975) changed over an initial measurement period of six months, but a job satisfaction measure, and the GHQ, took a further 12 months to show a significant level of change.

8.3.3 The job satisfaction and participation scores did not change significantly between the two stages. There is a small improvement for the stress score but it failed to reach significance level ($P<.05$). In order to enhance the level of job satisfaction among the younger age groups and the junior grades, the profile of their jobs needs to be examined and attention in particular given to increasing the amount of variety, task significance and autonomy they have in their jobs. Other findings, which would benefit from further exploration, would be the lower levels of job satisfaction and participation perceived by the specialist group, the high level of stress shown by the clerical group, and the lower score for participation of the secretary/ typist group. The reasons for these scores could be varied and are difficult to ascertain without further enquiries. The reason may well be the particular job profiles and the persons expectations not being met in the job content, particularly among the specialists, and how they feel as part of the organisation.

8.3.4 The analysis confirmed the previous research which has examined user's views of the computer system. The North American work for the Rand Corporation has in particular found that the functionality of the system plays an

important part in user satisfaction (Bikson and Gutek 1983; Bikson 1987). A British mail survey by the National Computing Centre (NCC) (1986) found that advantages for users included an increase in the speed and efficiency of working and in many instances smoother workflows were achieved. A shortcoming of the NCC survey was that responses to the mail shot are those of the employer's interpretation of the user's situation, though they also mentioned that users had to face a lack of user-friendliness and downtime as major irritants. Approximately half the OCAO users (51.5%) found the VDT "of real assistance" so there is potential for the level of job satisfaction to be increased, and this will probably occur as the professionals and managers see the computer providing them with the information that they require.

8.3.5 There was generally a positive attitude towards the computer but the interviews conducted on two occasions after the go live date (Shaw 1988) found the majority of users still developing their skills in the use of the system, mainly in the spreadsheet and database applications for which users were trained at a later stage than for the word processing package. There was an "air of optimism" about the benefits of the system and the increase in these benefits as applications were developed in the future (Shaw 1988).

8.3.6 There was also a clear indication that features of the system required more detailed investigation to establish underlying reasons for the number of users who found them unsatisfactory eg command language (see paragraphs 8.2.14 to 8.2.16). The most serious shortcoming that the users had

found in the systems performance was the systems response time. Unlike the high levels of dis-satisfaction at CHBC and OG there are only a small number at this site who commented on the problem of breakdowns.

8.3.7 System response times and breakdowns have been frequently found to be problems for users (Johanssen and Aronsson 1984; Dy 1985; Leppanen 1985; Komatsubara 1985; Grandjean 1987). Users adopt a variety of strategies to avoid these adverse effects. The strategies range from non-use to under use eg complete only limited tasks. There is also a variation as to what constitutes an acceptable SRT depending upon the nature of the task, the related manual activities and the characteristics of the computer software. The optimum values have been found to be within the range 0.2 seconds to 5 seconds (Galloway 1981, Barber and Lucas 1983, Shneiderman 1984). Generally tasks which involve the user in intellectual effort in their interaction with the system allow the greater SRTs to be tolerated (Eason 1982). The high level of concern, 54.5% of the users, over SRTs was not significant on analysis of the dichotomised groups on the job satisfaction and stress measures. Breakdowns, on the other hand, also add to the levels of stress due to creating delays and uneven workflows but were less of a problem at this site; only 9.1% regarding it as a problem.

8.3.8 The majority of respondents find the ambient temperature satisfactory. In comparison with the other sites OCAO staff were more satisfied with this aspect of their working life. People's perception of what is comfortable

obviously varies and comparison with views found in different offices can be striking. The fact that individuals cannot control their own environment was found in other studies (Hedge 1982, Wineman 1986) to be a major factor in dissatisfaction. However in smaller rooms, as in this building, there is a greater degree of control for the individual by opening doors or windows to achieve some modification in the ambient temperatures.

8.3.9 The levels of satisfaction for these users with the lighting, noise levels and furniture is generally high. There had been an improvement in the perceived lighting levels between the two stages. This probably reflects the attention paid to lighting prior to the installation of VDTs. The light fittings had suitable de-fusers fitted and users being located in cellular rooms had a degree of control over the lighting, particularly as they had also been given the opportunity to have individual desk lights. New chairs and desks had been purchased so that the main ergonomic features of the workstation and room lighting had been given some importance. This approach had been reinforced in the "awareness" training that had been given which included a module on workstation ergonomics.

Summary

8.3.10 This site is the first of two sites with the respondents from several job levels who gave different responses to the majority of the measures. In contrast to the clerical grade respondents at the former sites there were many more satisfied with the office environment, particularly the lighting. The lights were improved before

the introduction of the VDTs and a significant improvement emerged in the level of satisfaction at the Stage 2.

8.3.11 A greater proportion worked on the VDTs at this site, almost a third over 3 hours a day.The managerial and professional users making greater use of it than the small group of clerical staff, an indication of the better functionality than the "bespoke" systems at CHBC and OG.

8.3.12 On the JCI dimensions there was a job level effect but no change occurred between the stages which was also the case for the job satisfaction and stress measures. Many of aspects of the software packages were satisfactory for the majority of the users but over half were concerned about the poor system response times. A number of VDT characteristics were found to be related to the job satisfaction and stress levels. None of the health symptoms were reported as changing between the two stages of the survey.

Diagram 8.1

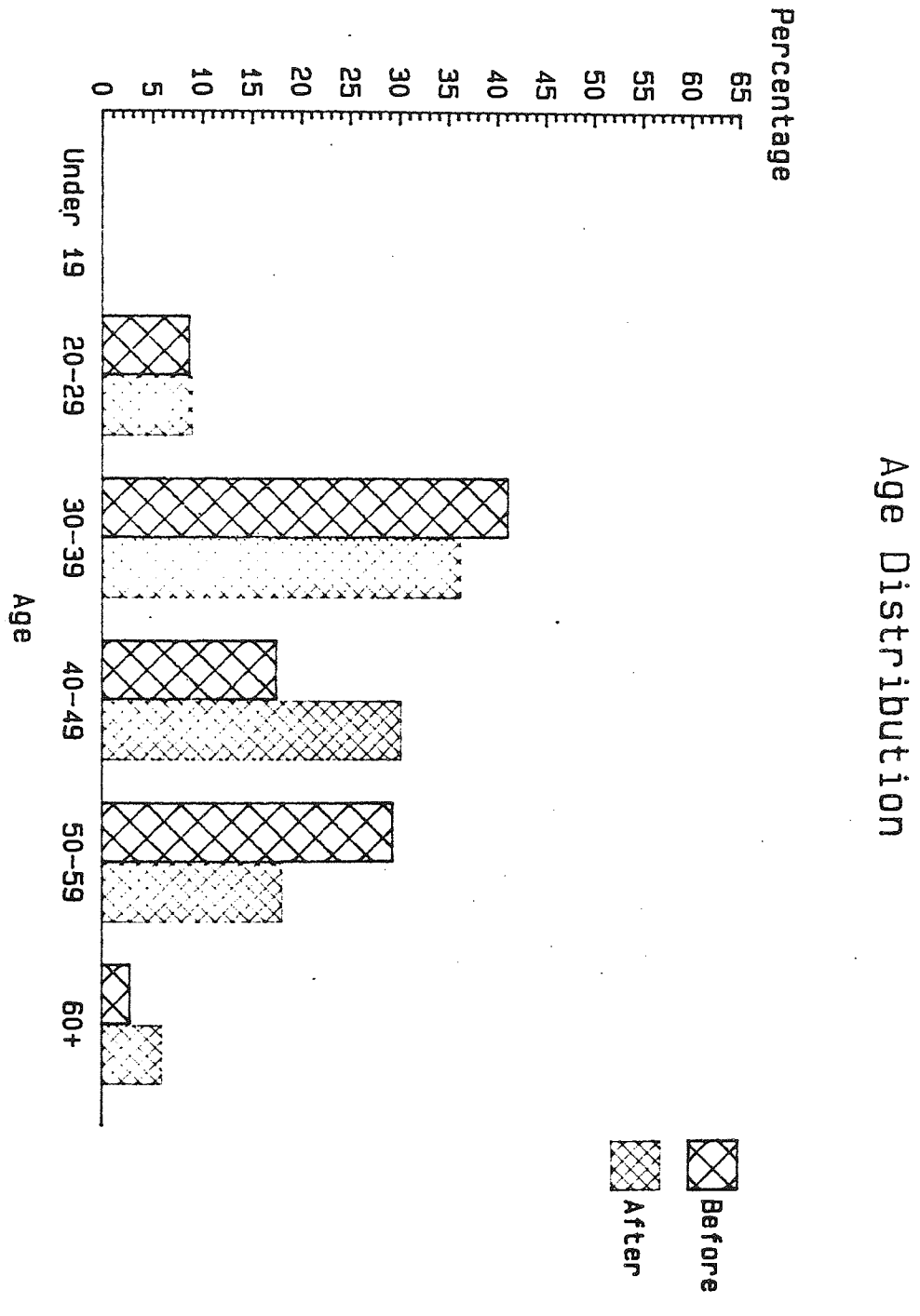

Age Distribution
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Age
Under 19
20-29
30-39
40-49
50-59
60+
Before
After

Diagram 8.2

Time Spent in the Civil Service

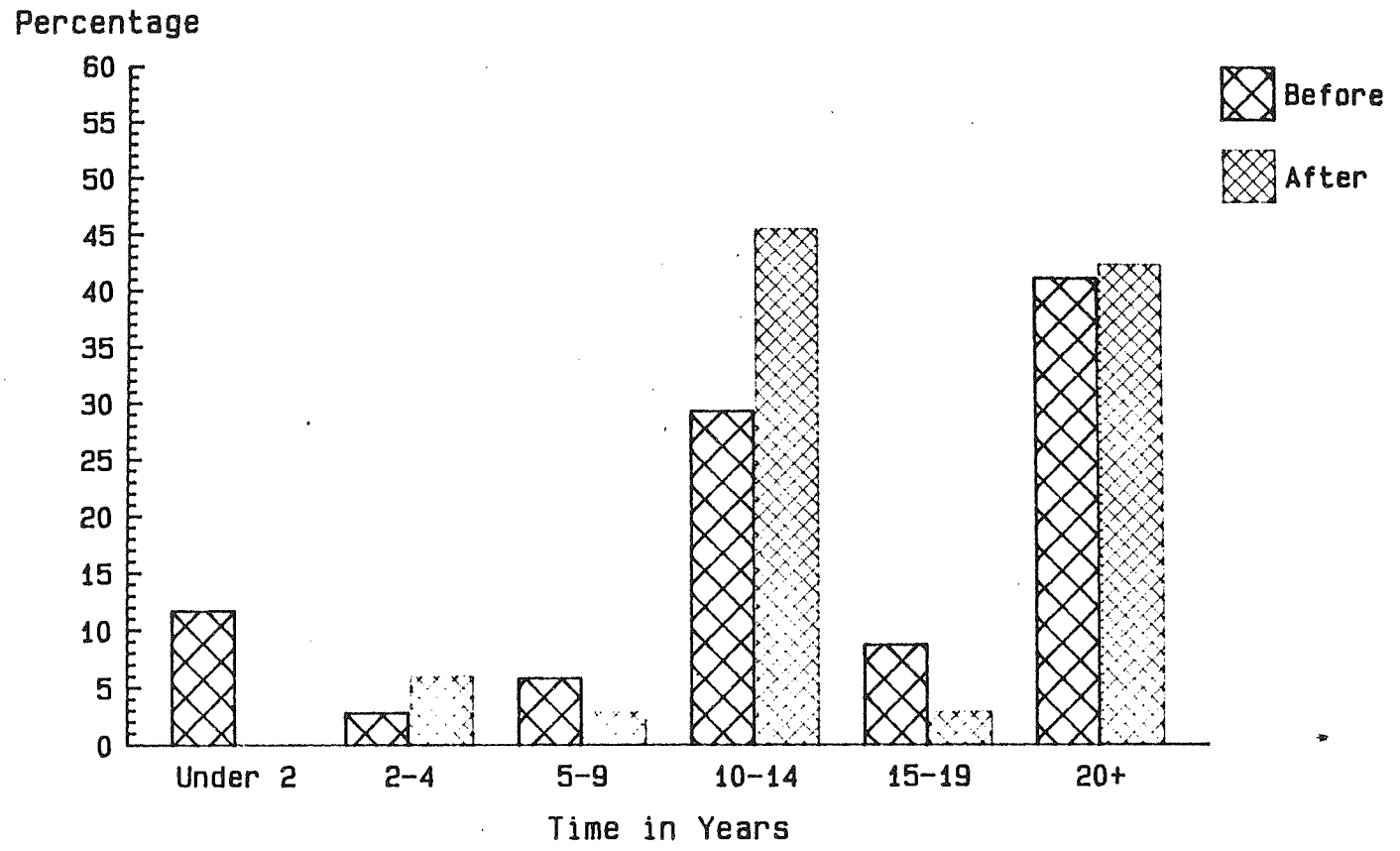


Diagram 8.3

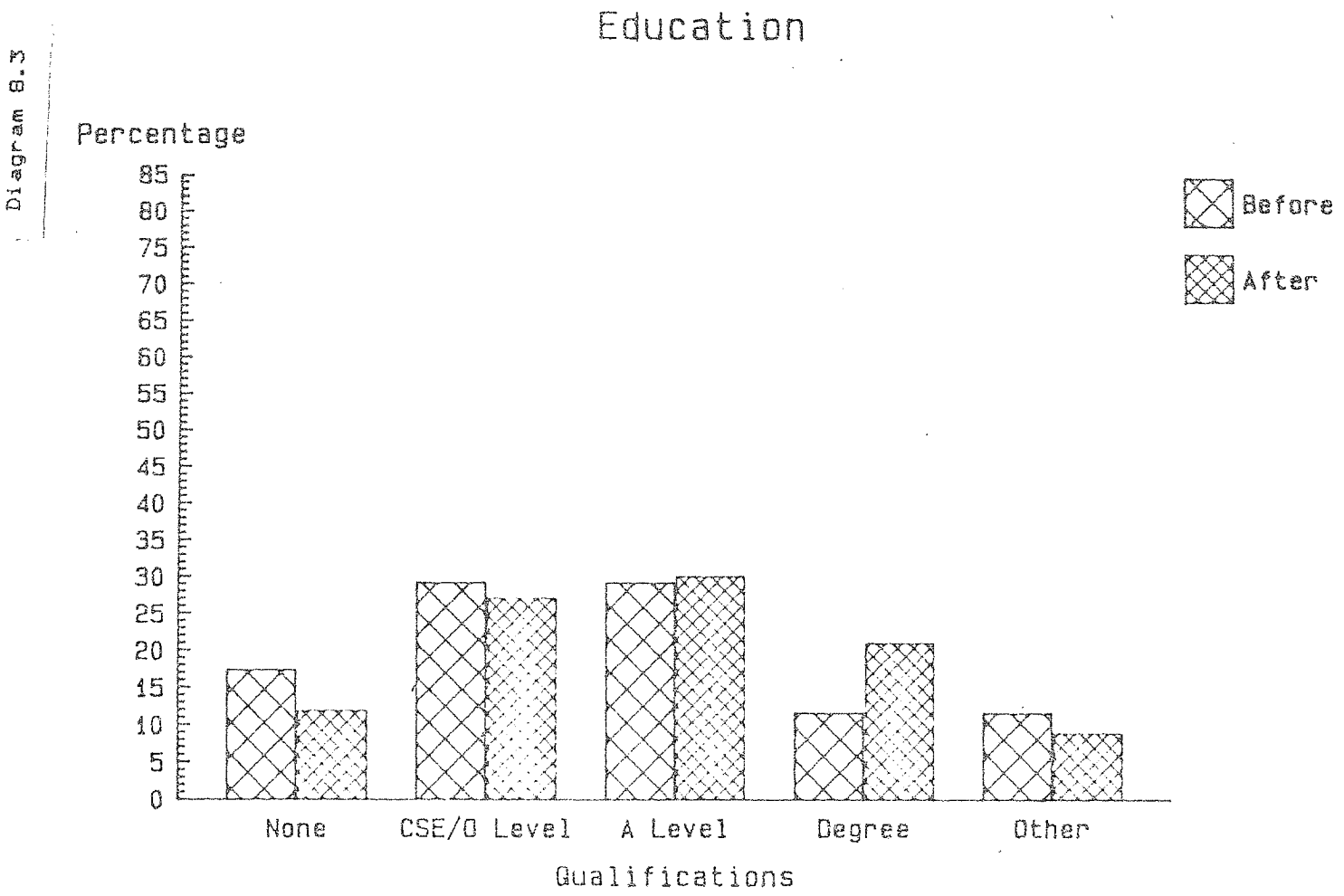
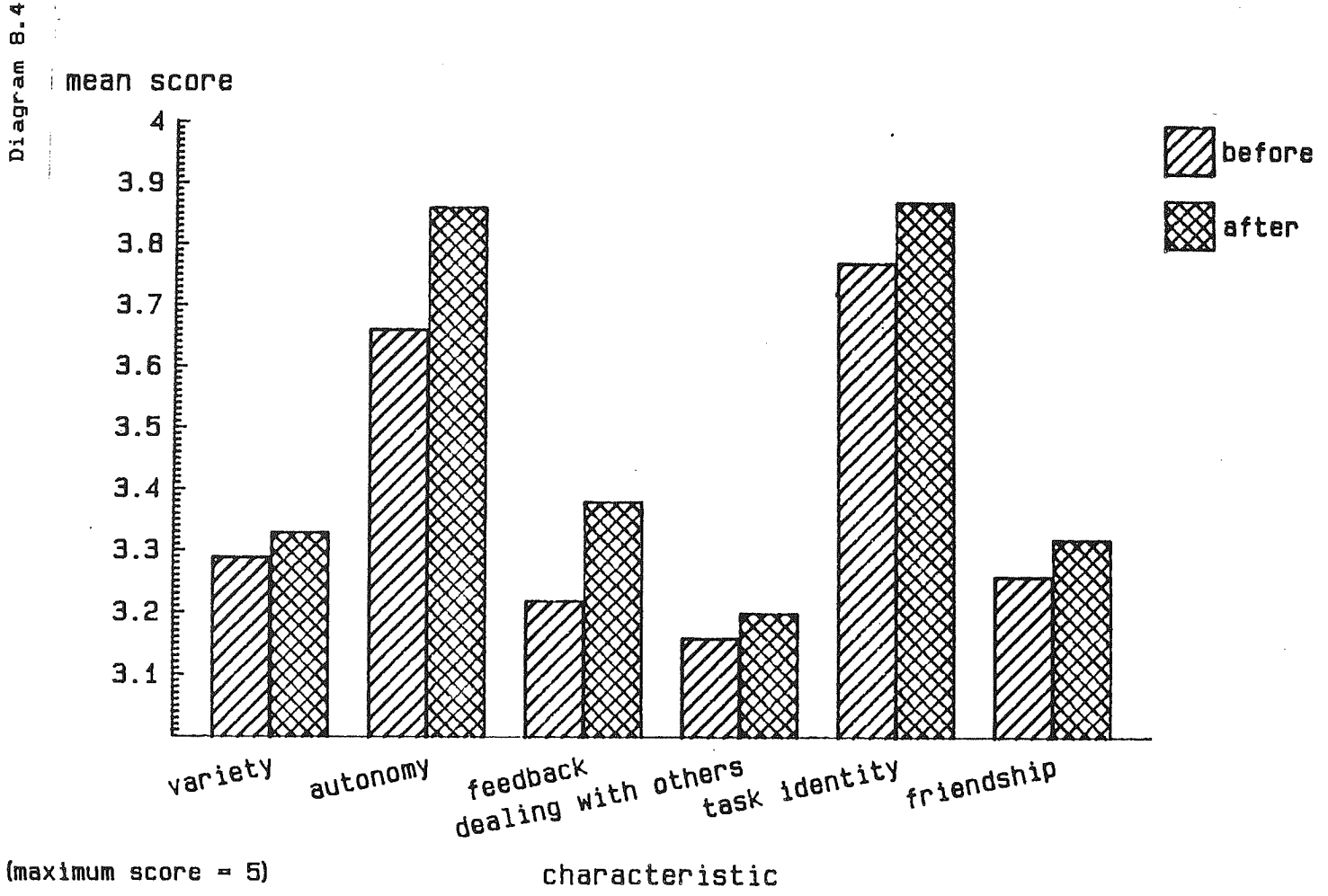

Education
Percentage
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Before
After
None
CSE/O Level
A Level
Degree
Other
Qualifications

Diagram 8.4


JOB CHARACTERISTICS
mean score
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
before
after
variety
autonomy
feedback
dealing with others
task identity
friendship
(maximum score = 5)
characteristic

9. THE REGIONAL DIRECTORATE HEADQUARTERS IN LONDON

Chapter Summary

The background to the introduction of the office support system into RD is outlined. The detailed findings of the survey for this site are given and the relationships between the variables are explored. The impact of the use of the VDTs on the managers and staff are discussed.

9.1 BACKGROUND

9.1.1 This case reflects the data obtained from the managers and staff working in the Regional Directorate headquarters in London. The Regional Directorate (RD) acts as the co-ordinating organisation, which manages the network of Regional and local office, and deals with the existing legislation administered by the Department, and also the planning, implementation, guidance and control of the policies which are formulated, in conjunction with Ministers, in Headquarter's policy divisions. There are twenty nine branches in the directorate each specialising in a particular field of the local office field of activity eg National Insurance contributions and compliance operations.

9.1.2 The main points of contact between the Department and the public are the 530 local offices in the UK employing approximately 60,000 staff. Their main task is to deal with claims to social security benefits from members of the public. Local offices vary in size: the smallest has under 20 staff; the largest over 200. Nearly half have 120 staff or more.

9.1.3 The local offices have managed links through seven Regional Offices to the Regional Directorate Headquarters. At the Headquarters there is a Regional Director with a large Directorate staff to support him. The Regional Offices are accountable to him. Appendix 3 shows in diagrammatic form the three major tiers of the organisation and the main off-line relationships with other parts of the Department.

The RD Office Support System

9.1.4 A preliminary study, by the Operational Strategy Division in May 1985, concluded that the application of new technology to some of the functions in the Regional Directorate would produce worthwhile benefits. Proposals were made to introduce an automated office support system into eight of the Branches. The objectives of the system were to:

a) improve the timing of instructions reaching local offices

b) improvements in the service given to local offices

c) provision of more up-to-date management information.

9.1.5 To achieve these main objectives the automated system will need to improve text processing systems, hardcopy print procurement, project control and costings work. Word-processing, data processing (in the form of spreadsheet and database functions), and electronic mail (including document transmission) are the main facilities required of the office support system.

9.1.6 The system comprises a network of 45 VDT, 19 printers with acoustic hoods, an optical character reader and a colour printer. The operating system is VMS and the processing power is achieved by three central processing units, which are housed in a separate air conditioned room away from the users. The supplier is Digital Equipment Co Ltd. There were teething problems in the initial weeks of use, but at the time of the post implementation data collection the system was regarded as acceptably reliable by the Systems Manager. There was no reliable data about the system response times (SRT). More recently some of the users considered that there had been some degradation of SRT (DHSS, Central Management Support Groups Report,August 1988).

9.1.7 The installation followed immediately on from the relocation of the staff from another building some miles away. The acceptance trials of the computer system were completed on 6 February 1987 and the "go-live" date was 9 February 1987.

RD Training

9.1.8 In December 1986 both users and non-users attended "awareness" training sessions. The content was the same as that given to the OCAO staff (see 8.1.7-8.1.10). The users of the system were trained in different skills depending upon the functions they were likely to use. The training was organised in modules lasting from 1 to 3 days each. The 109 users were trained over a period of 13 weeks. On-going training was given to consolidate the initial training when

users had returned to their normal workplace and using the VDTs.

The RD Office Environment

9.1.9 The Regional Directorate is located in a multi-storey building on a very busy main road in central London. The users are housed in small rooms on the 6th, 7th and 9th floors with room occupancy of 1 to 6 people. The building is air conditioned and windows do not open. On the whole the accommodation is of a reasonable standard, though some rooms are slightly overcrowded. The central computers are located in a separate room away from any of the users.

9.1.10 The lighting is by "daylight" fluorescent tubes fitted with plastic diffusers. Venetian blinds are fitted to all windows and are used to overcome glare and reflections in the screen. All the users were given the opportunity to have an eyesight test prior to using the VDT.

9.2 SURVEY RESULTS

9.2.1 The biographical information of the respondents is shown in diagram 9.1-9.3 (see pages 259-262). At Stage 1 there were 35 female (46.1%) and 41 (53.9%) male respondents with 22 female (40.7%) and 32 male (59.3%) respondents at Stage 2; 50% (48.7% wore glasses and 24.1% (13.2%) wore contact lenses (for Stage 1 figures are in parenthesis). The proportion of male to female respondents is higher than three of the five sites.

9.2.2 Respondents reactions to the office environment were varied in their degree of satisfaction of the different parameters considered (ambient temperature, light and noise- see table 9.1). Due to moving to the current building a few months before completion of the questionnaire the respondents could not score the summer responses at Stage 1. 11.3% considered at Stage 2 that they "very often" found the temperatures comfortable during the winter and 22.5% during the summer. There are sizeable numbers reporting that they find the temperature too cold (49.1%) in the winter, there is insufficient air movement (32.1% winter, 39.6% summer), and that it is too warm (25% in the summer). There was found to be improvement on only two measures ("too warm" and "temperature is constant"), from the level found before the system was installed to the post implementation stage (table 9.1a). It appears that the offices are generally not considered comfortable with little air movement and varying temperatures as well.

Table 9.1. View of Office Environment (Reporting "Very Often" or "Always")

	Stage 1		Stage 2	
	Winter	Summer	Winter	Summer
	%	%	%	%
Too Warm	2.7	Missing data	-	25.0
Comfortable temperature	10.6	"	11.3	22.5
Too Cold	46.6	"	49.1	4.2
Temperature Varies	32.0	"	14.5	33.3
Temperature Constant	10.7	"	25.1	8.3
No Air Movement	40.0	"	32.1	39.6
Draughts	17.3	"	15.1	2.1
Satisfactory Ventilation	22.7	"	19.9	8.3

Table 9.1a. Comparison of Mean Scores for respondents views of the Office Environment - Mann-Whitney U Test (P<.05)

	Before (N=75) Mean Rank	After (N=53) Mean Rank	Z	P
Too Warm (Winter	69.9 (59.8)	56.8 (44.9)	-2.29 (-2.67)	.02* (.008)**
Temperature Constant (Winter)	66.5 (59.2)	61.7 (46.1)	-0.76 (-2.13)	.45 (.03)

* P<.05 on a two tailed test ** P<.01 on a two tailed test
The respondents who also completed the questionnaire at Stage 1 and 2 (N=35) are shown in parenthesis.

Lighting

9.2.3 The lighting was regarded as satisfactory (see table 9.2) by a large percentage of respondents (84% Stage 1), this was also their view of the adequacy of daylight. There was apparently no problems with reflections, glare, or too much light. There was no objective measurements made of the lighting level for this research but the department's office services division, prior to the introduction of the VDTs, measured the lighting levels at this site to ensuret the requirements of the Departmental Information Technology Agreement were met.

Table 9.2. Views about the Office Lighting (Reporting "Often" to "Always")

	Stage 1	Stage 2
	%	%
Adequate Daylight	89.2	88.7
Reflection/Glare Flicker	10.7	13.2
Too Bright	9.3	15.1
Satisfactory	84.0	86.8
Too Dull	2.7	1.9

Noise

9.2.4 The noise levels of telephones and conversation in the office were found too distracting for a much higher number of people at this site than any of the other sites (table 9.3). This could be a reflection of the considerative work that many are dealing with and even minor disruptions create problems. In addition, there may also be an effect on the response level, due to the many telephone enquiries the

users receive from the large network of offices throughout the organisation which disrupt their considerative tasks. This possibility was not explored, but OCAO and OG, who are in similar position with regard to giving advice either to the public or to the local offices in the organisation, have percentages as high. There was no significant difference between the means scores for the noise items at the two stages. There is virtually no increase in the noise reported coming from office machines (5.3% to 5.7%), which may have been a possible effect of the VDT workstations.

Table 9.3. Views about the Office Noise Levels (Reporting "Often" to "Always")

	Stage 1 %	Stage 2 %
Too Quiet	5.3	3.8
Too Distracting	21.3	26.4
Office Machine	5.3	5.7
Outside Noise	5.3	7.5

Furniture

9.2.5 The discomfort of the chair does not appear to be a problem for the majority at this site. 88.6% were generally satisfied with their desk and 78.7% with the comfort of their chair before the receipt of the VDTs. These levels have however improved to 92.5% and 87.4% respectively, this shows no significant difference when comparing the means of the total scores between the pre-implementation and post-implementation questionnaires. New chairs and desks were

provided for the VDT at the time of installing the equipment and this has clearly satisfied the users.

Amount of VDT use

9.2.6 A number of staff, if not all, will probably find that their jobs have been modified with the introduction of the VDTs. Managers in particular will have computer facilities to create text and handle information, which they had not previously been available to them. The amount of time spent by the users on the VDT was reported as less than one hour a day by 46.3% and 25.9% between one and two hours. 27.9% said that they were working on the VDT more than two hours a day. 75.9% said they spent less than an hour at any one time on the VDT (tables 9.4a-b).

Table 9.4a. The average time spent on the VDT in a day

Hours	No	%
Less than 1	25	46.3
1-2	14	25.9
3-4	9	6.7
5-6	5	9.3
More than 6	1	1.9
Total	54	100.0

Table 9.4b. The number of hours spent on the VDT without a break

Hours	No	%
Less than 1	41	75.9
1-2	7	3.0
3-4	6	1.1
Total	54	100.0

Job Design and User Job Satisfaction

9.2.7 The job characteristics scores obtained from the JCI measure in the questionnaires completed by the respondents are shown in diagram 9.4 (see end of chapter). The comparison of the mean scores reveals higher scores for the post implementation stage on the characteristics of variety, autonomy, and friendship scales, though none of these differences were statistically significant. The other items were either the same mean score or lower.

9.2.8 The comparison of the responses for this site to other groups of respondents are shown in table 9.5, which sets out the means scores of other groups; a combined score from three DHSS sites (including RD) and the original researchers findings for their respondents across a wide spectrum of white collar jobs. The combined DHSS sites are higher on only one mean score, task identity, as is also the case for the original researchers scores. This result, possibly reflects the fact that the jobs in RD are generally regarded as being of a higher calibre in comparison to the jobs in the other two sites, particularly the AAs in Child Benefit Centre.

Table 9.5. Comparisons of Mean Scores for the Job Characteristics and Attitude Measures

	RD After computer installed		Study of 3 DHSS sites (OG, CHBC, RD) after computers installed		Original Researchers	
	Mean	SD	Mean	SD	Mean	SD
Variety	3.65 (3.61)	.54 (.60)	3.11	.74	2.93	3.55
Autonomy	3.87 (3.78)	.55 (.48)	3.84	.61	3.72	.83
Feedback	3.52 (3.57)	.56 (.75)	3.39	.63	3.03	1.05
Task Identity	3.68 (3.93)	.59 (.58)	3.76	.80	4.01	.95
Dealing with others	3.76 (3.66)	.70 (.68)	3.29	.72	4.14	.98
Friendship	3.69 (3.64)	.56 (.56)	3.54	.64	3.60	.96
Job Satisfaction	63.55 (62.30)	11.57 (13.99)	56.94	13.25	64.80	9.4
Participation	18.48 (18.10)	3.19 (4.11)	16.40	3.76	17.06	3.55
Stress	23.22 (25.10)	6.09 (7.01)	25.13	7.52	12.73a 12.37b	

NB: The figures in parentheses are pre-implementation scores
a = Male mean score of Banks et al (1980) population
b = Female mean score of Banks et al (1980) population

9.2.9 The job satisfaction, stress and participation scores are shown in table 9.5. The scores for this site compare favourable with the combined scores for the three sites (OG, CHBC, RD) and the populations of the original researchers. A students T-test found no significant change between the two Stages for both job satisfaction and participation even

though both scores had marginally improved (table 9.5a). The Pearson correlation coefficients for job satisfaction, participation and stress with the six job characteristics are shown at table 9.5b. Participation is positively associated with autonomy (P<.01) and job satisfaction with feedback) P<.05), but none of the other inter-correlations reached significance level.

Table 9.5a. Scores for Respondents Attitude Measures (P<.05)

	Before Go-live		After Go-live				
	Mean	SD	Mean	SD	df	T	P
Stress	25.09	7.01	23.22	6.09	122.87	1.62	NS
Participation	18.15	4.11	18.48	3.19	126.98	-0.53	NS
Job Satisfaction	62.25	13.99	63.56	11.57	124.49	-0.58	NS

NB: Maximum scores possible: Stress = 60 Participation = 25
Job Satisfaction = 90

Table 9.5b. Correlations among the Attitude Variables and the Job Characteristics (Post-Implementation)

	Job satisfaction	Participation	Stress
Variety	.32	.32	-.24
Autonomy	.20	.57**	-.33
Feedback	.37*	.18	-.32
Dealing with others	.31	.24	-.35
Task significance	.04	.25	-.15
Frienship	.16	.22	-.07

* P<.05b ** P<.01

9.2.10 An examination of the relationship between the job characteristics and other variables (gender, age, education and job level), at the post implementation stage, revealed that for this sample there is no significant effects. However, the participation score was the only variable to show any differences between the job level groups, when the job satisfaction, stress, and participation scores were examined for gender, age, education and job level differences (Table 9.5c). The low stress groups were also found to consider they have a significantly greater amount of participation than the high stress group. No such differences were found for the job satisfaction scores (Table 9.5d). Table 9.5e gives the scores on the job characteristics and attitude variables broken down by grade. There was only one person in the typist category so their responses are ommittedc from the table. The maximum variety and autonomy is seen by those in the managerial group, with

the specialist policy workers describing themselves as professionals. The greater amount of variety and autonomy at the senior levels is what one would anticipate from previous research (Katz 2978,1978(a), Rousseau 1982) as well as intuitively. The clerical group, however, perceive themselves as having more feedback and task significance than the senior grades. Whilst the managers consider that they have more dealings with people in their jobs, it is the clerical respondents who consider that they have the greatest friendship opportunities. On the other hand, the clerical group have the greatest stress but almost the least participation and job satisfaction.

Table 9.5c. Comparison of the scores for the Manager/Professional and the Clerical/Typist groups on participation - Mann-Whitney U Test (P<.05)

	Manager Professional (N=38) Mean Rank	Clerical/Typist (N=16) Mean Rank	Z	P
Participation	31.8	17.3	-3.11	.002

Table 9.5d. Comparison of the scores for the High and Low Stress Groups on participation - Mann-Whitney U Test (P<.05)

	Low stress (N=36) Mean Rank	High Stress (N=18) Mean Rank	Z	P
Participation	31.5	19.4	-2.67	.008

Table 9.5e. **Comparison of mean scores for the Job Characteristics and Attitude measures across the job levels (Post Implementation)**

	Managerial (N=21)		Specialist (N=17)		Clerical (N=13)	
Variable	Mean	SD	Mean	SD	Mean	SD
Variety	3.68	.46	3.67	.47	3.60	.47
Autonomy	3.94	.55	3.89	.62	3.82	.49
Task Significance	3.64	.57	3.69	.84	4.08	.68
Feedback	3.58	.56	3.25	.58	3.82	.44
Dealing with Others	3.80	.55	3.59	.69	3.56	.46
Friendship	3.59	.50	3.79	.65	3.80	.46
Stress	23.09	8.18	23.12	5.01	23.85	3.95
Participation	19.48	3.09	19.00	3.20	16.62	2.84
Job Satisfaction	63.67	13.35	65.42	9.22	60.69	12.92

9.2.11 The amount of interaction by this group of staff with the VDT in any one day is not very large, being less than two hours for 72.2%. There was only one respondent who said they spend more than six hours a day at the VDT. The respondents were analysed by a students T-Test, to examine if there were any differences between those using the VDT under two hours a day (low users) and those using it more than two hours a day (high users). The high users consider that they suffered more eye strain, irritated and burning eyes, as well as more back pain, than the low users (table 9.6). All means on the four items for the high users fell between "occasionally" and "often". There was no difference found between the groups on any of the attitude variables.

An analysis of the group using the VDT for one hour or more a day, with those using it less than one hour a day, found no statistically significant difference on any variable.

Views of the Computer System

9.2.12 Views of various aspects of computer system show clearly that the users find the messages very clear (87.0%), commands are regarded as straightforward (77.8), and 88.9% found that it is of assistance in their job. Well over half found that they had some difficulty in learning to use the system, which appears to be a contradiction to those who found it easy to learn how to use (72.2%) (table 9.7). It may be of some value in trying to find out whether there is some remedial action that can be taken, either to ascertain how the training can be amended to help this type of user in future or to give some additional training if the system is not fully understood after being used. A little over a third of the users find the system tiring to use, which is in contrast to the high percentage of respondents who found the system clear, straightforward, and of definite assistance to them.

Table 9.6. Students T-Test of high level users (more than two hours) vs low level users (two hours or less)

	Low Users (N=39) Mean	SD	High Users (N=15) Mean	SD	df	T
Eyestrain	1.59	.75	2.67	1.11	19.12	-3.46**
Burning eyes	1.33	.53	2.33	1.35	15.70	-2.80*
Backpain	1.54	.79	2.20	.94	22.01	-2.42*
Irritated eyes	1.54	.72	2.27	1.22	17.86	-2.17*

** P<.01 * P<.05

Table 9.7. Respondents views of the computer system (The percentage of respondents who "agree" or "agree strongly" with each item)

	%
The system messages are easy to understand	87.0
The replies given by the system are very "businesslike"	77.8
Using the system requires a lot of concentration	63.0
The commands are all straight-forward to use	77.8
I had considerable difficulty learning to use the system	66.4
The system does not provide me with the correct help	37.0
I had no difficulty learning to use the system	73.2
Some of the commands are rather obscure	53.7
The system is a real assistance to my work	88.9

9.2.13 Table 9.8 shows features of the VDT screen and keyboard which are regarded as unsatisfactory. There are clearly major concerns about the system response times (SRT) which are experienced, 77.8% reporting this as a problem. The features of the screen, although not a problem for the majority, are large enough, approximately (10%), to warrant some effort to improve this level of dissatisfaction. The brightness, contrast and glare from the screen are reported by lower numbers at this site than CHBC and OG. It is not known if poor legibility of the documents, which is a concern for 9.3%, is due to the design and layout of the forms or the longhand entries which are illegible on the forms handled by the users. Breakdowns of the system are a concern to a relatively small percentage, 9.3% and these numbers are small in comparison to the numbers at OG and CHBC (76.0% and 87.8% respectively).

9.2.14 An analysis comparing dichotomised groups on the two variables, job satisfaction, and stress, with features of the screen and keyboard found no significant difference.

Users Health

9.2.15 Table 9.9 sets out the percentage of users at this site expressing a discomfort from "often" to "always" on the 19 item health symptom inventory. Despite the items showing differences between the two stages (12 items an increase, 5 a decrease, 2 no change), the comparison of the scores for each symptom between the first and second completion of the questionnaire (Mann-Whitney U Test) found that none of the differences between the scores was statistically significant. This result was found for the comparison of all

respondents at both stages, as well as for those who completed a questionnaire on both occasions.

Table 9.8. Problems of the Visual Display Unit (The percentage of respondents reporting "Often" or "Always")

	%
Flickering of the screen	7.4
Brightness of the screen	11.1
Contrast of the screen	11.1
Distance to the screen	11.1
Angle of the screen	5.6
The paper documents are not always clearly legible	9.3
The characters on the screen are not clearly recognisable	-
Glare on the screen	13.0
The response time of the system after keying is not adequate	77.8
The servicing is not adequate	7.5
Distance of the keyboard	3.7
Angle of the keyboard	5.6
Breakdowns causing interruptions	9.3

9.2.16 An examination of the Health Symptom Inventory for differences by gender, job level, educational qualification and age was performed with a Mann-Whitney U Test. Tables 9.10 and 9.11 show the items which reached significance level ($P<.05$) at the post-implementation stage. There is only one of the symptoms, "sore wrists", which is common to both gender and job level differences. The females and clerical/typing staff are invariably reporting these

symptoms more frequently. The dichotomised job satisfaction groups had only one symptom, changed colour vision, which was statistically different between the groups scores (Table 9.12).

9.2.17 The comparison with three of the sites in DHSS (OCAO, CHBC and OG), shows a lower level of reported complaints than two of the three sites CHBC and OG; table 9.13 gives the percentages for comparison of the other three sites. As with those sites, there has been no analysis of the actual sick leave records to see if any relationship existed with the reports of ill health symptoms and the absenteeism rates.

Table 9.9. **Health Systems reported as attributable to the respondents work (The percentage reporting "often" to "always")**

	Before Go-live %	After Go-Live %
Eyestrain	20.0	20.4
Stiff Neck	12.0	13.0
Burning Eyes	5.3	13.0
Sore Shoulders	9.3	15.6
Back pain	12.0	16.7
Irritated eyes	10.7	14.8
Blurred Vision	5.3	9.3
Stiff arms	1.3	-
Stiff legs	2.7	1.9
Neck pressure	8.0	3.7
Skin rash	1.3	1.9
Stomach pains	1.3	1.9
Swollen joints	2.7	-
Hand cramps	2.7	1.9
Sore wrists	-	1.9
Changed colour vision	-	1.9
Fainting	-	-
Loss in fingers	-	-
Headaches	12.0	16.7

Table 9.10. Comparison of the scores by gender on the health symptoms - Mann-Whitney U Test (P<.05)

	Female (N=22) Mean Rank	Male (N=32) Mean Rank	Z	P
Stiff Neck	34.4	22.8	-2.96	.003
Blurred vision	32.5	24.1	-2.39	.02
Sore wrists	30.7	25.3	-2.24	.03
Headaches	32.2	24.3	-2.00	.05

Table 9.11. Comparison of the scores for the Managers/ Professional and the Clerical/Typist groups on the health symptoms - Mann-Whitney U Test (P<.05)

	Manager/ Professional (N=38) Mean Rank	Clerical/ Typist (N=16) Mean Rank	Z	P
Eyestrain	24.7	34.1	-2.13	.04
Sore shoulders	25.3	32.8	-1.97	.05
Back pain	23.0	38.1	-3.51	.0004
Hand cramps	25.1	33.2	-2.68	.008
Sore wrists	25.9	33.3	-2.12	.04
The loss of feelings in the fingers	26.5	29.9	-2.20	.03

9.2.18 The mean scores for the GHQ12 (the stress measure) are shown in tables 9.5 and 9.5a. The reduction in the mean scores from 25.09 to 23.22 (the maximum stress score would be 60) is not statistically significant. The overall mean scores for the three DHSS sites are also shown in table 9.5.

When the stress scores were dichotomised, and the health symptoms examined for the two groups, there were only two symptoms which were statistically significant for the two groups (Table 9.12a

).

Table 9.12. Comparison of the scores for the high and low job satisfaction group on the health symptoms - Mann-Whitney U Test)P<.05)

	Low job satisfaction (N=15) Mean Rank	High job satisfaction (N=39) Mean Rank	Z	P
Changed colour vision	30.1	26.5	-2.30	.02

Table 9.12a. Comparison of the scores for the high and low stress groups on the health symptoms - Mann-Whitney U Test (P<.05)

	Low stress (N=36) Mean Rank	High stress (N=18) Mean Rank	Z	P
Sore shoulders	23.7	35.1	-3.08	.002
Changed colour vision	26.5	29.5	-2.02	.05

Table 9.13 **The percentage of the respondents stating "often" to "always" for the Health Symptom Inventory (pre-implementation)**

	OCAO %	RD %	OG %	CHBC %
Eyestrain	20.6	20.0	34.1	52.2
Stiff neck	2.9	11.9	25.6	59.3
Burning eyes	5.8	5.3	15.2	19.4
Sore shoulders	-	9.3	16.5	41.8
Back pain	8.8	12.0	17.1	49.3
Irritated eyes	8.8	10.7	24.4	25.4
Blurred vision	5.8	5.4	15.2	19.4
Stiff arms	2.9	1.3	5.5	13.4
Stiff legs	-	2.6	9.1	14.9
Neck pressure	-	8.0	15.9	40.3
Skin rash	-	1.3	-	6.0
Stomache pains	2.9	1.3	-	4.5
Swollen joints	-	2.7	0.6	7.5
Hand cramps	-	-	8.5	13.5
Sore wrists	-	-	4.3	9.0
Changed colour vision	-	-	0.6	1.5
Fainting	-	-	1.2	-
Feeling loss in fingers	2.9	-	1.2	-
Headaches	11.7	12.0	5.4	49.3

9.3 DISCUSSION

9.3.1 The users at this site are doing a variety of jobs at different levels in the organisation, from secretarial and clerical level to middle managers. The VDTs have been introduced to improve the efficiency of their work, particularly the use of the word processing facility, and also, to provide more information which is readily available for managers and policy makers. The amount the VDT is used in the working day varies considerably. The majority of respondents using it between half an hour and two hours a day. Any changes in the job characteristics due to the introduction of VDTs have not been found.

9.3.2 Due to the nature of job grading it is not surprising that the greater amount of variety and autonomy is experienced by the managers and professionals. The jobs also provide them with a level of task identity which is lower than the means scores at the other DHSS sites, at the post implementation stage, though previously it was higher. This result is not easily reconciled with the researcher's personal experience, that the majority of respondents working at the higher levels in the organisation would see the overall view of the organisations objectives and tasks more clearly and could identify with them in their own work. In particular, this site would be expected to contrast favourably with the AA and AO grades at the CHBC and OG sites.

9.3.3 People working in highly enriched job conditions usually rate the various job characteristics more highly

(Fried and Ferris 1987), as was also found by O'Reilly and Caldwell (1979) for respondents in enriched working conditions in their study.

9.3.4 There was generally a positive attitude to the computer because of the assistance it gave to them in their work; with messages and commands being clear and straightforward, and the majority finding it easy to learn how to use the system. A substantial number of the respondents found that the computer system presented difficulties of learning for them, which is in contrast to the much simpler tasks the computer performs at CHBC where the majority of users found it very easy to learn.

9.3.5 The incidence of breakdowns is not of a serious nature compared to CHBC and OG, but what concerns the users at this site is the poor SRT. This is a similar phenomena to that at OCAO, where those users also had a problem with SRT. The SRT is well in excess of ten seconds for some of the sub-routines within the word processing package, though acceptance trials met an average performance of 3.5 seconds. There was no detailed record kept at this site on SRT, but the system performs a similar set of functions as at OCAO, and it is probably the word processing software package that is the most unsatisfactory. A further contributory factor to the relatively unsatisfactory SRT performance, was the fact that there was an uneven distribution of VDTs to the three central processing units.

9.3.6 The level of participation did not change significantly for these users during the period of the enquiry. It was also strikingly noticeable that their scores

on participation were well above the means score for the combined sites (table 9.5). The method of involvement of the potential users in the development of implementation plans and the system, was a representative from each user section. About six to nine representatives sat on a Steering Group and a User group. A monthly newsletter was also issued by the Systems Manager advising users of the latest developments and progress of implementation. An evaluation study by the Central Management Support Group reported that the users expressed satisfaction with this process (DHSS, Central Management Support, 1988).

9.3.7 Despite the health symptoms not showing any statistically significant deterioration between the two stages, it is a matter of interest that the overall level of symptoms being reported are so much lower than OCAO and CHBC. The respondents views may be influenced by their feelings about their job characteristics and job satisfaction. The generally high status of these respondents compared to CHBC and OG could also be influencing the situation, especially as for some symptoms the low job holders report them with a greater frequency.

9.3.8 In contrast with many previous studies into the use of VDTs that found differences between users and non-users, the lack of statistically significant change in the level of stress between the two stages of this study is an important finding. If some of the features of the computer system were improved, particularly SRT, there could well be further improvements achieved. However, no account has been taken as to whether self reported illness manifests itself in

increased sick leave or absenteeism, and further enquiries would be required to establish any behavioral changes at this particular site.

9.3.9 The reactions to the office environmental noise were not as adverse as found in some studies. The users distracted or interrupted in their work by telephones or conversation was higher at RD (21.3% to 26.4%) than at the other sites, but not as high as the studies sited by Sundstrom (1986). The disturbance from office machines was also high at approximately 5% for this site but not as high as found in other research.

9.3.10 The lighting levels are satisfactory for between 84% and 87% which compares favourably with CHBC and OG. A smaller number (under 15%) found that reflections, brightness, and glare are a problem. No measurements were made of the lighting levels in working areas for this study. Consideration by management could be given to checking that the lighting levels are within the recommended bands for clerical and VDT work (250 to 500 lux - Cakir et al 1980). One of the problems for a mixed task environment is that the levels recommended for VDT and traditional clerical work are different, besides the needs of individuals also differing. One possible solution is to have subsidiary lighting available under the control of staff at individual workplaces (Wineman 1986, Sundstrom 1986). This is partially met by the cellular room that most users work in at this site. Characteristics of the physical work surroundings may indirectly effect the attainment of intrinsic rewards through the ability to obtain maximum accomplishment of the

task.

9.3.11 The dissatisfaction with the office climatic conditions is a significant problem, almost half the users finding the offices too cold and with insufficient air movement. It is a major problem for the satisfactory management of office climates that there is such a wide range of views about the desirable temperatures, humidity and air movement. A BOSTI (Buffalo Organisation for Social and Technological Innovation) study found that unsatisfactory temperatures were directly linked to a decline in job satisfaction (cited by Sundstrom 1986). Any improvements that can be achieved in employees' perceptions about the office environment, would probably reduce the general level of dissatisfaction and feelings of stress. It is not possible, of course, to achieve maximum benefits for everyone, but aiming for an optimum level of acceptance could pay dividends.

9.3.12 Finally, the findings for this site emphasise that the lower level office worker has a poorer view of their job, though only participation was found to be related to the differences between the job group's scores at the post-implementation stage, and none of the job characteristics. In addition, following the introduction of the computer system, no change was found at a statistically significant level for job satisfaction and stress. The functionality of the system was appreciated and regarded as an aid to the performance of the users work. An improvement in the system's performance, particularly the system response time, would contribute more significantly towards further improvement in the users attitudes to their jobs.

9.3.13 Different parameters of the office environment were dissatisfying to the users but there were minor improvements following the introduction of the VDTs. Noise was a problem for more users than at the other sites probably due to the location on a main route in central London.

9.3.14 The users reported lower levels of use of the VDT than at the OCAO where a comparable system was being used. A high proportion, as at OCAO, were concerned about the system response times. The dichotomised high VDT user group reported significantly greater different degrees of eye complaints and back pain than the low user group.

9.3.15 The JCI scores were generally higher than for the other sites, but again there was no change in the scores on this measure between the two stages. Differences between the job levels emerged as a significant feature of this sites results as at OCAO. The analysis failed once again to find any differences for the attribute variables over the period of the survey.

Diagram 9.1

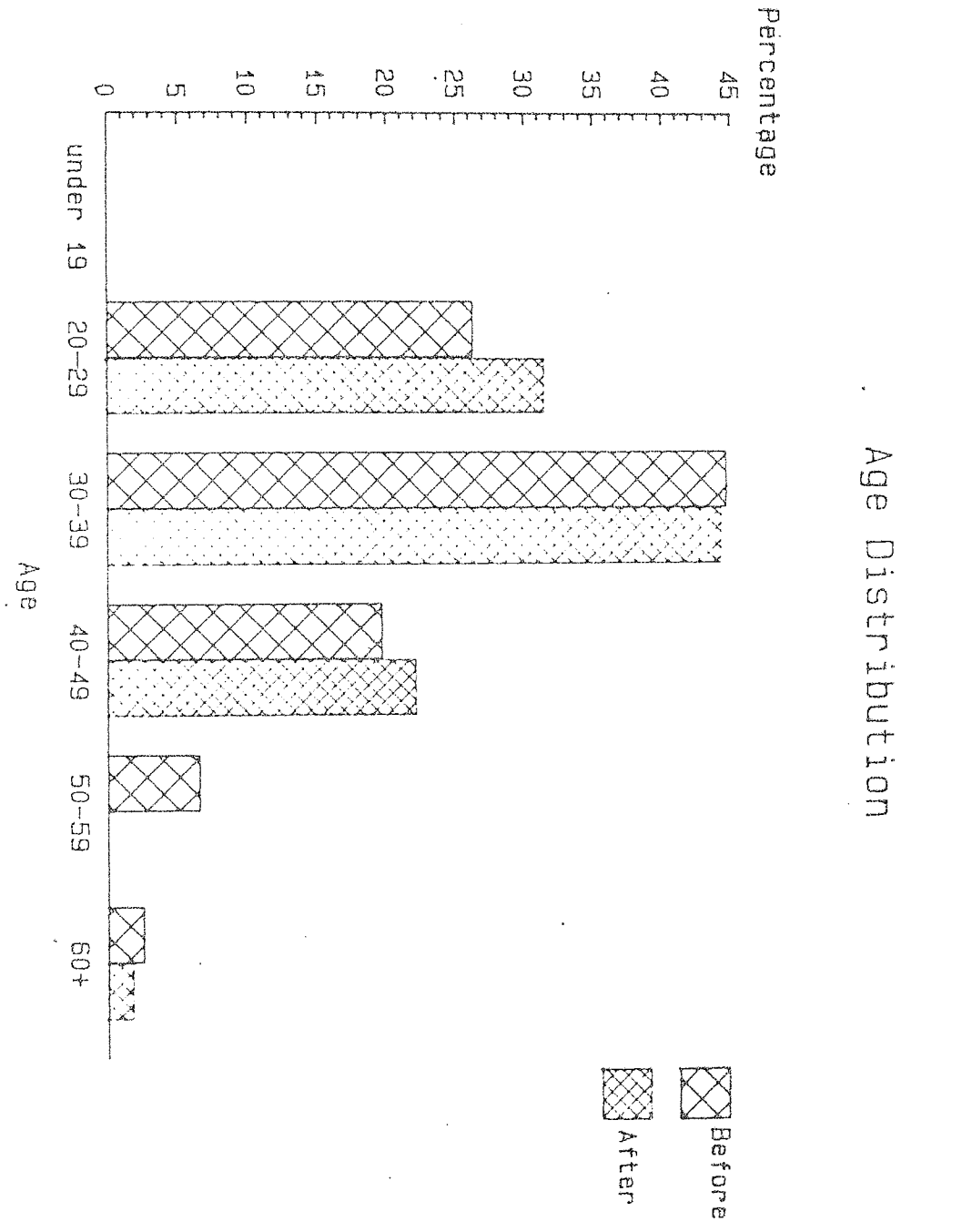

Age Distribution
Percentage
0
5
10
15
20
25
30
35
40
45
under 19
20-29
30-39
40-49
50-59
60+
Age
Before
After

Diagram 9.2

Time Spent in the Civil Service

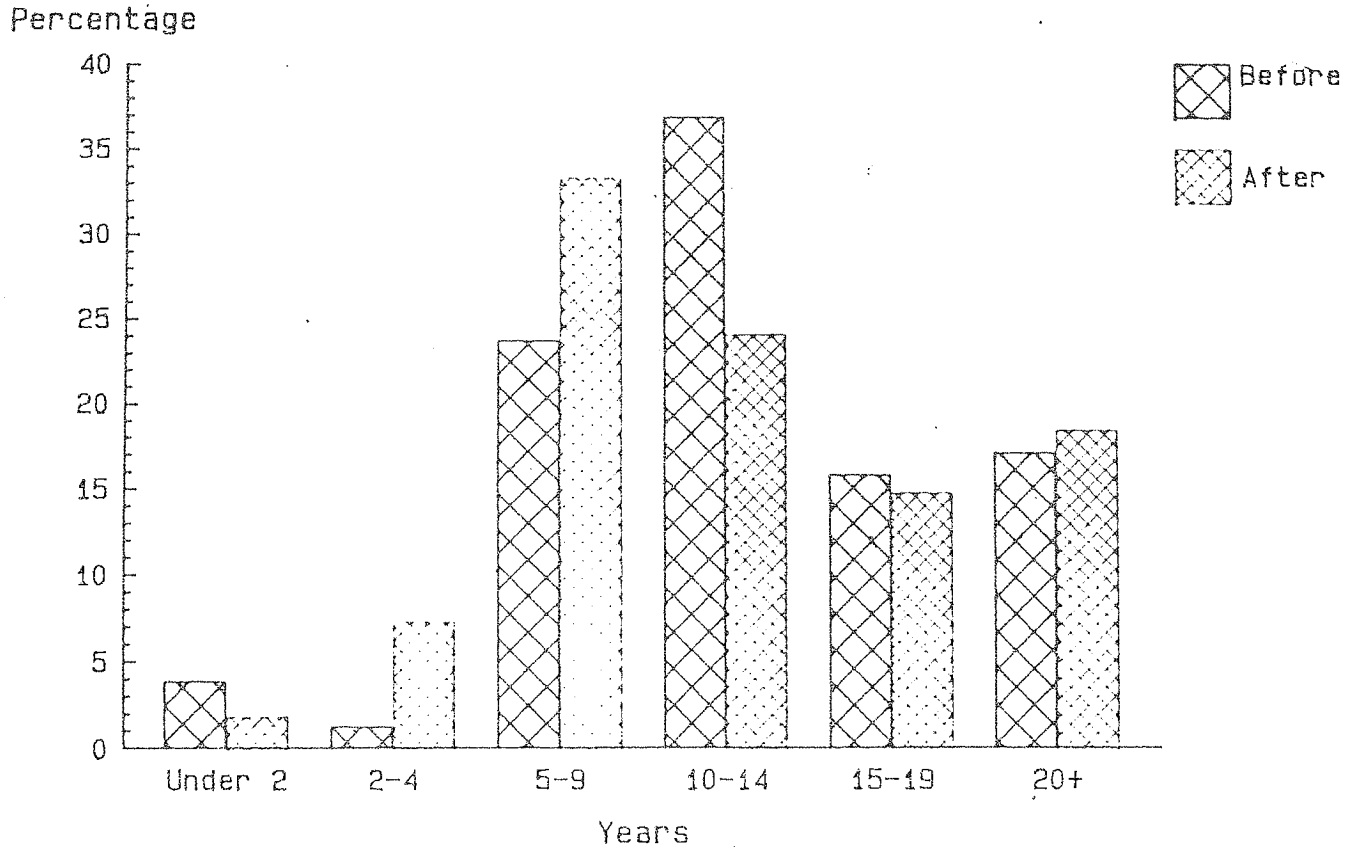


Diagram 9.3

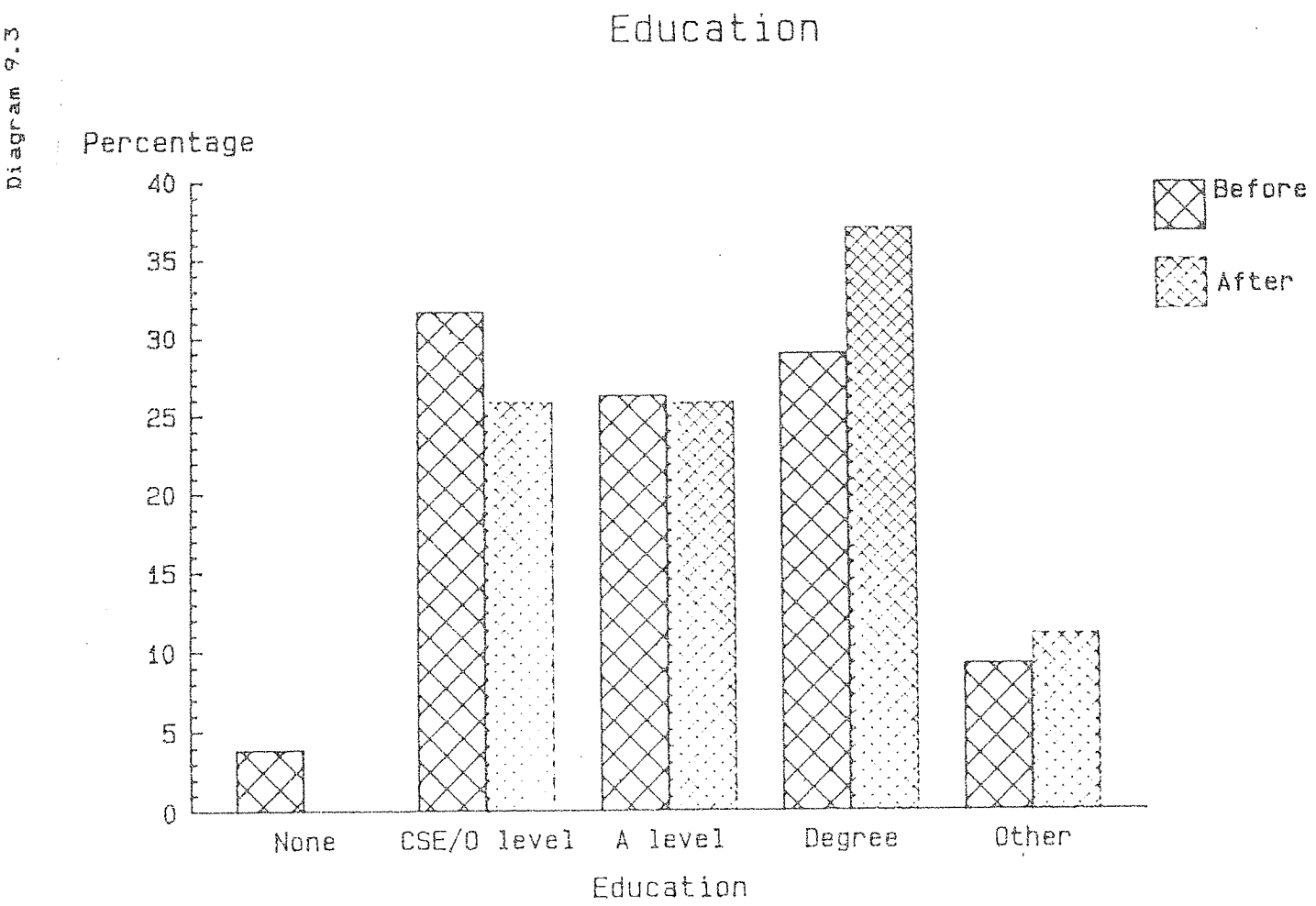
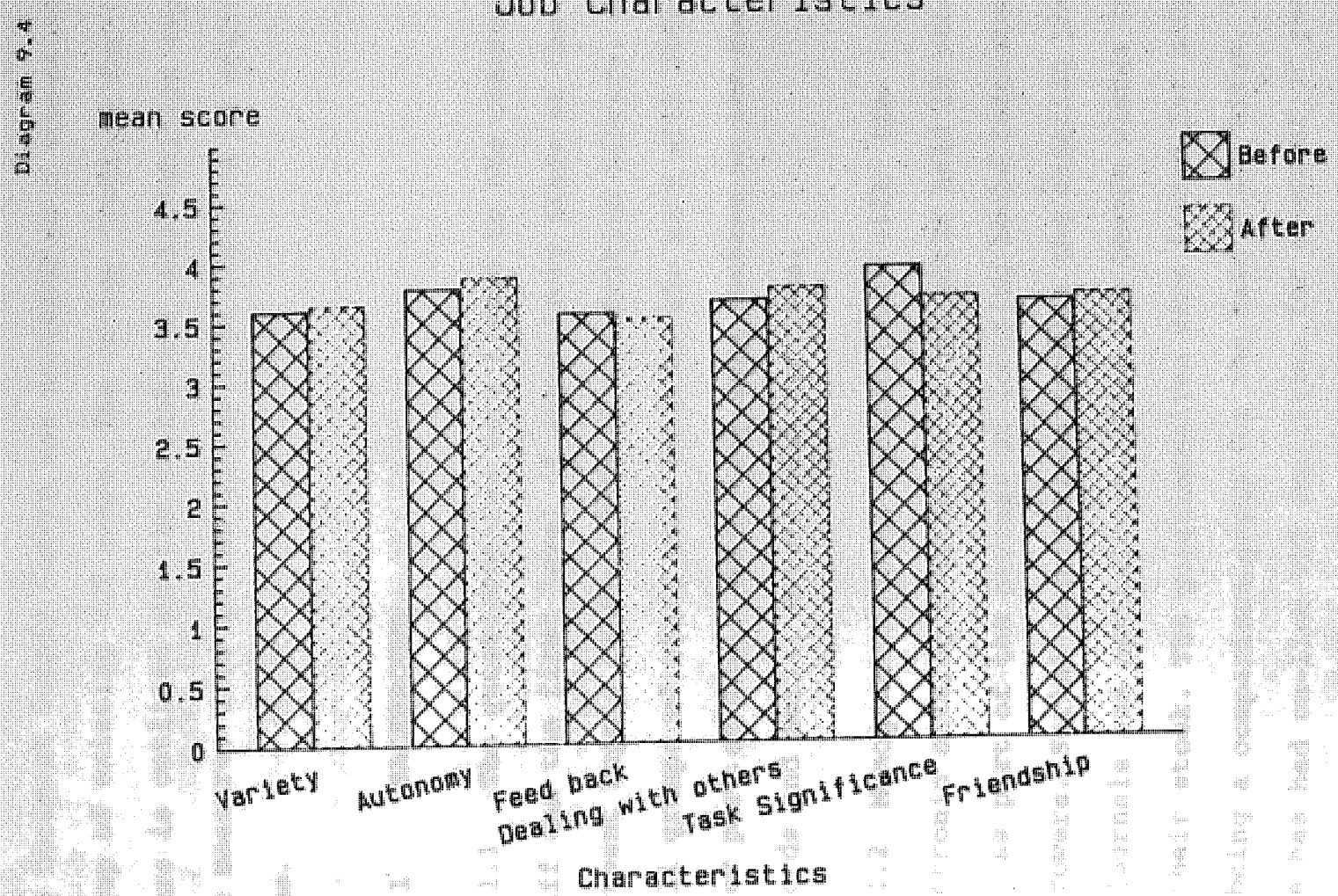

Education
Percentage
40
35
30
25
20
15
10
5
0
Before
After
None
CSE/O level
A level
Degree
Other
Education

Diagram 9.4


Job Characteristics
mean score
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Variety
Autonomy
Feed back
Dealing with others
Task Significance
Friendship
Characteristics
Before
After

10. THE BRITISH LIBRARY, DOCUMENT SUPPLY CENTRE, WETHERBY

Chapter Summary

The Document Supply Centre was surveyed as a comparison group of existing VDT users. The survey findings for these users is outlined and the variable's relationships explored. The measures used in the survey were found to be stable over time.

10.1 BACKGROUND

10.1.1 The questionnaires were issued to the clerical staff and the first level of supervisory grade at the Document Supply Centre (DSC) of the British Library. Two small groups of staff were included who work with VDTs as a major part of their work; they were working in the Monograph Records and Serial Acquisition Sections.

10.1.2 Monograph Records section deals with the electronic catalogue database of the books held in stock at DSC, as part of the process of locating books requested by borrowers. Serial Acquisitions handles the ordering process of journals and periodicals, which the Centre wishes to hold in their stock. The questionnaires were issued for purposes of being a comparison group for the main study sites. This site has had on-line VDT facilities for a number of years, so the data obtained from the respondents will reflect VDT user's views who have had experience using the systems. They cannot be considered as a matched control group because they are from a different organisation from the other sites, albeit in the public sector, and no detailed matching has

been completed. It was considered of some value, however, to examine whether there was any change in the main measures, over time, of a group of respondents using VDTs as well as a group of controls at the other sites.

10.2 SURVEY RESULTS

10.2.1 The biographical information of the respondents is shown in diagrams 10.1-10.3 (see pages 289-292). At stage 1 there were 27 female (67.5%) and 13 male (32.5%) respondent with 20 female (62.5%) and 12 male (37.5%) respondents at Stage 2; 34.4% wore glasses and 12.9% wore contact lenses at the post-implementation stage.

Office Environment

Room Atmosphere

10.2.2 The Document Supply Centre of the British Library is located in Boston Spa, Nr Wetherby, Yorkshire, in a central modern multi-storey block built in the 1970s, with surrounding single storey buildings built during the war. The single storey premises have been modernised for their current purposes. The accommodation appears to be of a good standard.

10.2.3 The respondents reactions to the office environment were varied, as was found for the other sites, in their degree of satisfaction of the parameters considered (ambient temperature, light and noise - see Table 10.1). Only 5.0-6.0% considered that they "very often" found the temperatures comfortable during the Winter and none during the Summer. There are sizeable numbers reporting that they

find the temperature varies too much (20-30% in winter), there is insufficient air movement (68-87% winter, 42-62% summer), and that it is too warm (25-30% winter and 32-34% summer). On the whole there is no clear picture of improvement on the items between completion of the two questionnaires. The only statistically significant change was a higher mean score at the second stage for those saying the summer temperature varies (Table 10.1a). This was found to be the case for all respondents being compared at both stages, as well as for those who only completed the questionnaire at Stage 1 and 2. In comparison with the larger population drawn from three DHSS locations, between 33% and 45% of these respondents considered that they felt the temperature was comfortable and between 14.7% and 27.3% found the ventilation satisfactory or on a regular basis.

10.2.4 There is a very small percentage at this site who find that the temperatures are satisfactory, which is the lowest of the four sites. The results may be influenced by their proximity to the book storage areas, which have to be kept at cooler temperatures for reasons of ideal book preservation conditions, than was found to be the case for sedentary workers feeeling comfortable (Sundstrom 1986).

Table 10.1. View of Office Environment (Reporting "Very Often" or "Always")

	Stage 1 Winter %	Stage 1 Summer %	Stage 2 Winter %	Stage 2 Summer %
Too Warm	30.0	32.5	25.0	34.4
Comfortable temperature	5.0	-	6.2	-
Too cold	2.5	5.0	-	12.5
Temperature varies	20.0	12.5	31.2	37.5
Temperature Constant	15.0	12.5	15.6	18.7
No air movement	87.5	42.5	68.7	12.5
Draughts	15.0	5.0	12.5	6.2
Satisfactory ventilation	-	2.5	3.1	3.1

Table 10.1a. Comparison of mean scores for respondent's views of the Office Environment - Mann-Whitney U Test

	Before (N=40) Mean Rank	After (N=32) Mean Rank	Z	P
The temperature varies (Summer)	31.7 (25.19)	43.3 (40.13)	-2.61 (-3.29)	.01 (.001)

NB The respondents who also completed the questionnaires at Stage 1 and 2 (N=19) are shown in parenthesis.

Lighting

10.2.5 The lighting was regarded as satisfactory (see Table 10.2) by only 43.7% (Stage 2), which is considerably below the OCAO finding, with 90.3% "often" satisfied at the

Stage 2 questionnaire completion. There was a significant reduction in those reporting the lights as too bright, and an increase in those considering the lighting as too dull between the two Stages (Table 10.2a), which reflects the impact of some changes made to the lighting in Monograph Records' work area. This was found for the comparison of all respondents at both stages, but not for those who had only completed the questionnaire at Stage 2 as well as Stage 1. There are large percentages of respondents who thought that reflections, glare or too much light troubled them. These are not as great as in some studies which report glare and brightness affecting 70-80% of VDT users (Stammerjohn et al 1981). There was no objective measurements made of the lighting levels, and users at DSC had not been asked about the source of discomfort so that corrective action could be taken to ensure the correct positioning of fluorescent tubes.

Table 10.2. Views about the Office Lighting (Reporting "Often to "Always")

	Stage 1 %	Stage 2 %
Adequate Daylight	25.0	40.6
Reflection/Glare Flicker	45.0	43.7
Too Bright	55.0	21.9
Satisfactory	40.0	43.7
Too Dull	7.5	18.7

Table 10.2a. **Comparison of mean scores for respondents views of the Office Lighting - Mann-Whitney U Test (P<.05)**

	Before (N=40) Mean Rank	After (N=32) Mean Rank	Z	P
Too bright	41.9 (32.5)	29.8 (24.7)	-2.52 (-1.68)*	.02 (.09)
Too dull	32.5 (28.2)	41.6 (33.8)	-2.20 (1.46)*	.03 (.14)

NB The respondents who also completed the questionnaires at Stage 1 and 2 (N=19) are shown in parenthesis.

* Not significant - P<.05)

Noise

10.2.6 The noise levels of telephones and conversation in the office were found too distracting for 18.7% (Stage 2). The levels for this item reported at this site are similar to three of the DSS sites (OCAO, OG and RD). The same percentage was found for those who were distracted regularly, by office machines and outside noise (see Table 10. 3), which is a much higher level than the other four sites. There was no significant difference between the mean scores for noise items at the two stages.

Table 10.3. **Views about the Office Noise Levels (Reporting "Often" to "Always")**

	Stage 1 %	Stage 2 %
Too Quiet	-	3.1
Too Distracting	25.0	18.7
Office Machine	15.0	18.7
Outside Noise	7.5	18.7

Furniture

10.2.7 The comfort of the chair is an important feature in the working environment, as is the suitability of the desk for the performance of the office worker's tasks. 77-80% were generally satisfied with their desk, and 80-84% with the comfort of their chair respectively for the two Stages. There had been no changes to the workstations during the survey, which was confirmed by the Mann-Whitney U Test comparison for the scores being non-significant.

Job Design and User Job Satisfaction

10.2.8 There were no changes to the computer systems being used by these respondents between the two Stages of questionnaire completion. The amount of time spent daily by the respondents on the VDT was reported as less than three hours a day by 3.1% and over 5 hours by 71.9%. Eight people said they were working on the VDT more than 6 hours a day. A large number (43.8%) said they spent more than three hours at any one time on the VDT without a break (Table 10.4b). These long periods of working at the VDT are not regarded as very satisfactory by a number of authors (Cakir et al 1980; Purdham 1984; Dy 1985; Knave et al 1985; Health and Safety 1986).

Table 10.4a. **The average time spent on the VDT in a day**

Hours	No	%
Less than 1	1	3.1
1-2	-	-
3-4	8	25.0
5-6	15	46.9
More than 6	8	25.0

Table 10.4b. The number of hours spent on the VDT without a break

Hours	No	%
Less than 1 hour	5	15.6
1-2 hours	13	40.6
3-4 hours	14	43.8

10.2.9 The job characteristics scores obtained from the JCI measure completed by the respondents are shown in Diagram 10.4. The Mann-Whitney U Test comparison of the scores reveals no significant change between the two Stages on the characteristics scores. However, Table 10.5 sets out the mean scores of other groups for comparison purposes; a combined score from three DHSS sites and the original researchers findings for their respondents across a wide spectrum of white collar jobs. The combined DHSS sites are on all measures, except one (Feedback), lower means than DSC, but this could probably be due to the fact that DSC has no administrative assistant grades (AA) as respondents,

whereas there are about 30% of the respondents at the combined sites who are AAs. The AAs at CHBC had lower post implementation scores than the other sites for the JCI.

Table 10.5. Comparisons of mean scores for the Job Characteristics and Attitude measures between Sites

	DSC After computer installed N=32 (40)		Study of 3 DHSS sites (CHBC, OCAO, RD) after computers installed		Original Researchers	
	Mean	SD	Mean	SD	Mean	SD
Variety	3.36 (3.40)	.32 (.50)	3.11	.74	2.93	.90
Autonomy	4.15 (4.19)	.44 (.49)	3.84	.61	3.72	.83
Feedback	3.38 (3.35)	.65 (.72)	3.39	.63	3.03	1.05
Task Identity	4.16 (3.98)	.61 (.64)	3.76	.80	4.01	.95
Dealing with others	3.30 (3.41)	.58 (.72)	3.29	.72	4.14	.98
Friendship	3.90 (3.91)	.52 (.61)	3.54	.64	3.60	.96
Job satisfaction	60.44 (60.08)	8.81 (9.77)	56.94	13.35	63.80	9.40
Participation	17.40 (17.98)	3.33 (3.03)	16.40	3.76	17.06	3.55
Stress	23.37 (22.70)	6.85 (5.40)	25.13	7.52	12.73a 12.37b	

a = Male mean score of Banks et al (1980) population.
b = Female mean score of Banks et al (1980) population.

10.2.10 An examination, of the links between the job

characteristics and other variables, revealed that for this sample there is a significant effect of job level on autonomy and friendship that respondents perceive they have in their work (see Tables 10.6).

10.2.11 Managers and professionals perceive they have more autonomy and friendship than the other job levels (Table 10.6), which in the case of friendship is in contrast to the trend found at the other sites. It is not clear why this should be at this site but could be related to many factors of the organisation, such as low turnover coupled with strong out of work social activities creating strong friendships among those who have been in the organisation for long periods, or possibly due to the small non-random sample. It is clearly an aspect that requires further enquiry.

Table 10.6. Comparison of the scores by job level for the job characteristics inventory and the attitude variable - Mann-Whitney U Test (P<.05)

	Managers/ Professionals (N=8) Mean Rank	Clerical (N=23) Mean Rank	Z	P
Autonomy	8.4	18.6	-2.75	.006
Friendship	11.2	18.6	-2.01	.05
Job Satisfaction	10.3	18.9	-2.35	.02

The job satisfaction, stress and participation scores are shown in Table 10.6a. There is only a modest change between the two stages for the job satisfaction and stress scores, which are not statistically significant. A recent study in

one Northern Ireland government department among clerical staff, using the same job satisfaction measure, had a mean score of 57.50 (Bell 1987). No significant results were found when examining the correlations between the attitude variables and the JCI (Table 10.6(b)). Between the completion of the questionnaire at the two stages, an atmosphere of growing uncertainty had developed in the whole organisation due to a management scrutiny into the number of staff required in the organisation. There was a strong current of anxiety concerning job security at the time, and a reduction in the opportunity for promotion, so it is interesting to find that, despite that climate appertaining, there was no real change in these attitude variables. A Mann-Whitney U Test of these variables with the biodata found a gender and job level effect on the job satisfaction and stress scores. Females have more job satisfaction and feel less stress than the males (Table 10.6c). Whilst the clerical grades have more satisfaction than the higher grade (Table 10.6), which is in contrast to the position found at the other sites surveyed. This site has a particular problem of promotion blockage at middle management grades and this may be influencing the job satisfaction score for the management grades.

Table 10.6(a). Scores for Respondents Attitude Measures

	Before go-live (N=40) Mean Rank	After go-live (N=19)* Mean Rank	Z	P
Stress	29.6	30.9	-.29	.78
Participation	31.0	28.0	-.64	.53
Job Satisfaction	29.9	30.3	-.09	.93

NB: * = Respondents who completed the questionnaire at both stages

Table 10.6b Correlations among the Attiude variables and the Job Characteristics (Pearsons Correlation Coefficient - Two-tailed test)

	Job Satisfaction	Participation	Stress
Variety	-.17	-.11	-.14
Autonomy	.09	.45	-.19
Feedback	.08	.26	-.09
Dealing with others	-.39	.20	.40
Task significance	.003**	.10	-.16
Friendship	.10	.34	-.03

** P<.01

Table 10.6c. **Comparison of the scores by gender for the Attitude Variables - Mann-Whitney U Test (P<.05)**

	Female (N=20) Mean Rank	Male (N=12) Mean Rank	Z	P
Job Satisfaction	19.8	11.0	-2.67	.01
Stress	13.7	21.3	-2.23	.03

Features of the Visual Display Terminal and the Job Satisfaction, Participation and Stress Measures

10.2.13 The amount of interaction by this group of staff with the VDT over 3 hours is very large. There was only one respondent who said they spend less than three hours a day at the VDU (Table 10.4a). A Mann-Whitney U test compared those using the VDT less than 4 hours in a day and those using it for more. There were no significant differences found for the job characteristics and attitude variables. Only one health symptom, however, emerged as being experienced more frequently by the high users; that was stiff legs ($Z = -2.52$ $P<.05$).

10.2.14 Views of various aspects of the computer system show that a good proportion of the users find the messages clear (84.4%), commands are regarded as straightforward (87.5%), it is of assistance in their job (93.7%) and is easy to learn how to use it (81.2%) (Table 10.7). It may be of some value in trying to find out why the smaller number of dissatisfied users have problems, in order that some remedial action can be taken, either to ascertain how the training can be amended to help the minority of users in

future, or to give some additional training if the system is not fully understood after being used. Nearly half of the users find the system requires a good deal of concentration, which is in contrast to the high percentage of respondents who find the system clear, straightforward and of definite assistance to them.

Table 10.7. Respondents views of the computer system (The percentage of respondents who "agree" or "agree strongly" with each item)

	%
The systems messages are easy to understand	84.4
The replies given by the system are very "businesslike"	40.6
Using the system requires a lot of concentration	37.5
The commands are all straightforward to use	87.5
I had considerable difficulty learning to use the system	18.7
The system does not provide me with the correct help	9.4
I had no difficulty learning to use the system	81.2
Some of the commands are rather obscure	21.9
The system is very tiring to use	46.9
The system is a real assistance to my work	93.7

10.2.15 Table 10.8 shows features of the VDT screen and keyboard which are regarded as unsatisfactory. There are clearly concerns about the breakdowns which are experienced, 37.5% reporting this as a problem. The servicing is regarded as unsatisfactory by 18.7%. This could be a reflection of the real situation with regard to the service provided, or

the response could be influenced by the amount of disruptions experienced.

Table 10.8. Problems of the visual display terminal (The percentage of respondents reporting "Often" to "Always") (N=32)

	%
Flickering of the screen	6.2
Brightness of the screen	12.5
Contrast of the screen	18.7
Distance to the screen	6.2
Angle of the screen	21.9
The paper documents are not always clearly legible	3.1
The characters on the screen are not clearly recognisable	-
Glare on the screen	37.5
The response time of the system after keying is not adequate	18.7
Distance to the keyboard	12.5
Angle of the keyboard	12.5
Breakdowns causing interruptions	37.5

10.2.16 Glare and contrast from the screen are of concern to a good number of users (Table 10.8), as also is the angle of the screen. Despite the screen angle being adjustable, it is the other ergonomic variables, of the desk and chair dimensions, which constrain the angle of the screen being made satisfactory. These problems, with the exception of the glare, are lower than other studies, which report between 30% and 60% of users complaining of these features. Almost all respondents (93.7%) consider that the system response

times (SRT) are unsatisfactory. A number of studies (Johansson and Aronsson 1984; Dy 1985; Leppanen 1985; Komatsubara 1985; Grandjean 1987;) into computer use have found that SRT is linked to dissatisfaction and stress ,and also has an influence upon the users performance in both quality and efficiency of the work performed.

10.2.17 An analysis comparing the high and low scorers on the two variables, job satisfaction, and stress, with features of the screen and keyboard, found several significantly related. The low job satisfaction scoring group find that they have difficulties with the angle of the keyboard, otherwise there are no other differences between these groups (Table 10.9a). The relationship of the stress scores with the system variables, indicates a more serious picture than that presented by the job satisfaction relationships. Those who find the system providing "messages are easy to understand" and "straightforward commands" have the least amount of stress (Table 10.9b); the reverse is true for those who find that "the commands are rather obscure".

Table 10.9a. Comparison of the scores for the high and low Job Satisfaction groups - Mann-Whitney U Test (P<.05)

	Low satisfaction (N=12)	High satisfaction (N=20)		
	Mean Rank	Mean Rank	Z	P
Problems with the angle of the keyboard	20.3	14.2	-1.98	.05

Table 10.9b. **Comparison of the scores for the high and low stress groups - Mann-Whitney U Test (P<.05)**

	Low Stress (N=24) Mean Rank	High Stress (N=8) Mean Rank	Z	P
The systems messages are easy to understand	18.2	11.4	-1.97	.05
The commands are straightforward	19.1	8.8	-2.98	.003
Commands are rather obscure	14.1	23.6	-2.56	.01

Users' Health

10.2.18 As at the other four sites, the questionnaire issued to the users explored the level of symptoms users experienced and the degree of stress associated with work. Table 10.10 sets out the percentage of users expressing discomfort from "often" to "always" on the 19 item Health Symptom Inventory. In view of the items showing differences between the two stages (13 items an increase, 16 a decrease), a Mann-Whitney U Test compared the scores for the symptoms between the first and second completion of the questionnaire and found that none of the differences between the scores were statistically significant. A comparison was also made between the health symptom scores for the high and low job satisfaction scores, and it was found that the low scoring group had a greater incidence of "stiff neck" and "sore shoulder" symptoms (Table 10.11a).

10.2.19 The levels of reported symptoms are generally similar to other studies (eg Laubli et al 1980; Hedge 1984; Dainoff 1982), with visual symptoms at around 50% and headaches 39%. The comparison with the DSS sites shows a

higher level of reported complaints than the other sites (15 of the 19 symptoms) (see Table 10.11). The comparison of the high and low stress groups scores on the health symptoms found, that similar to the job satisfaction dichotomous groups, it was the "sore shoulders" symptom which was reported most; there was also found to be a higher incidence of reported "neck pressure" as opposed to "stiff neck" for the job satisfaction groups (Table 10.11b). There has been no analysis of the actual sick leave records, to see if any relationship existed with the reports of ill-health symptoms.

10.2.20 The mean stress scores for the respondents are shown in Tables 10.5 and 10.6(a). The slight increase in the mean score from 22.70 to 23.37 (the maximum stress score would be 60) is not statistically significant. The overall mean scores for the other three DSS sites are also shown in Table 10.5.

10.2.21 Analysis was conducted on the data for any differences in the scores between the respondents in the two sections, Serial Acquisitions and Monograph Records, at the post-implementation stage. The only differences are related to the respondent's views on the office environment in Serial Acquisitions Section who find it slightly quieter (Table 10.12), and the lighting is too bright.

Table 10.10. **Health Symptoms reported as attributable to the respondents work. (The percentage reporting "often" to "always")**

	Stage 1 %	Stage 2 %
Eyestrain	47.5	45.7
Stiff Neck	27.5	15.6
Burning Eyes	12.5	18.7
Sore Shoulders	17.5	15.6
Back pain	32.5	21.9
Irritated eyes	30.0	45.7
Blurred vision	22.5	15.6
Stiff arms	5.0	-
Stiff legs	10.0	-
Neck pressure	20.0	15.6
Skin rash	12.5	3.1
Stomach pains	12.5	9.4
Swollen joints	2.5	-
Hand cramps	2.5	3.1
Sore wrists	2.5	-
Changed colour vision	7.5	3.1
Fainting	2.5	-
Loss in fingers	2.5	-
Headaches	40.0	31.2

Table 10.11. **The percentage of respondents stating "often" to always" for the Health Symptoms Inventory (Stage 1)**

	DSS Sites				Document Supply Centre
	CHBC	OG	OCAO	RD	
Eyestrain	52.2	34.1	20.6	20.0	47.5
Stiff neck	59.3	25.6	2.9	11.9	27.5
Burning eyes	19.4	15.2	5.8	5.3	12.5
Sore shoulders	41.8	16.5	-	9.3	17.5
Back pain	49.3	17.1	8.8	12.0	32.5
Irritated eyes	25.4	24.4	8.8	10.74	30.0
Blurred vision	19.4	15.2	5.8	5.4	22.5
Stiff arms	13.4	5.5	2.9	1.3	5.0
Stiff legs	14.9	9.1	-	2.6	10.0
Neck pressure	40.3	15.9	-	8.0	20.0
Skin rash	6.0	3.0	-	1.3	12.5
Stomach pains	4.5	-	2.9	1.3	12.5
Swollen joints	7.5	0.6	-	2.7	2.5
Hand cramps	13.5	8.5	-	2.7	2.5
Sore wrists	9.0	4.3	-	-	2.5
Changed colour vision	1.5	0.6	-	-	7.5
Fainting	1.5	-	-	-	2.5
Feeling loss in fingers	-	1.2	2.9	-	2.5
Headaches	49.3	5.4	11.7	12.0	40.0

Table 10.11a. **Comparison of the scores for the high and low Job Satisfaction groups - Mann-Whitney U Test (P<.05)**

	Low Satisfaction (N=12)	High Satisfaction (N=20)		
	Mean Rank	Mean Rank	Z	P
Stiff Neck	20.3	14.2	-2.10	.04
Sore Shoulders	21.2	13.7	-2.39	.02

Table 10.11b. **Comparison of the scores for the high and low stress groups - Mann-Whitney U Test (P<.05)**

	Low Stress (N=24)	High Stress (N=8)		
	Mean Rank	Mean Rank	Z	P
Sore Shoulders	14.5	22.4	-2.24	.03
Neck Pressure	14.6	22.2	-2.22	.03

Table 10.12. **Items where there is a significant difference (P<.05) between the respondents in the two sections at Document Supply Centre at the post-implementation stage**

	Monograph Records (N=16)	Serial Acquisitions (N=16)		
	Mean Rank	Mean Rank	Z	P
Noise - Too Quiet	13.9	19.1	-1.97	.05
The lighting is too bright	13.4	19.6	-1.97	.05

10.3 DISCUSSION

10.3.1 The purpose of this study was to evaluate the interrelationship between demographic factors, job characteristics, office environmental variables and the outcome variables (job satisfaction, stress and health outcomes) which were influenced by the introduction of visual display terminals into the office environment of a Government Department. The users at this site are all administrative officers and Executive Officers. This site was being used as a comparison site at which VDTs were already being used at the Stage 1 completion of the questionnaire. The amount the VDT is used in the working day is generally more extensive than the other DSS sites surveyed.

10.3.2 It is significant, on most of the job characteristic items, the DSC jobs score higher than the DSS sites, and the sample population used by the questionnaire's designers. The characteristics which require further detailed enquiry would be feedback and dealing with others, and could well be related to be absence of administrative assistant's (AAs) from the DSC population, whilst approximately 30% of the DSS sample are AAs.

10.3.3 It was found that there are differences due to job level upon the amount of autonomy and friendship in the different jobs. The maximum scores for autonomy are found in the 20-29 age group. The rising expectations, which may come with more mature age, may be the reason for this, but it requires further enquiry in order to be substantiated. It could also be a spurious effect for this particular group of

respondents. The reasons are not clear, so further enquiries are necessary of this group of respondents to explore the reasons for their views on autonomy and friendship aspects of the job.

10.3.4 There was generally a positive attitude to the computer because of the assistance it gave to them in their work. A large minority of the respondents found that the computer system presented difficulties because of commands being obscure, concentration in its use being required to a considerable extent, and almost half found it very tiring to use. Smith et al (1980) found VDT users on one of three sites they examined, scored higher on a general fatigue scale than controls, which may have some similarity to those users finding the VDTs tiring to use. On the other hand, improvement could be sought by improved training in the use of the VDT and work carried out to improve the software of the system.

10.3.5 The level of participation did not improve significantly for these users during the period of the enquiry. It is noticeable, that their scores on participation were above, both the DSS sites, and also the researchers original sample population.

10.3.6 The incidence of breakdowns is clearly of a serious nature, and not only did a large percentage of users consider it a problem in answer to the specific item in the questionnaire, but it also merited comment from many users in the open questions at the end of the questionnaire inviting comments on the system. Glare and the angle of the screen are difficulties which, with a small additional

amount of enquiry and finding solutions to the problems, would raise satisfaction with the system. There are several guidelines to assist in this area (eg Cakir et al 1980). No basic awareness training has been given recently to users in ergonomic principles, which could provide possibilities for users to explore options and find some solutions for themselves, particularly with regard to the position of the keyboard and screen. The problems indicated by the results described at paragraph 10.2.17 could be due to the desk top having inadequate space. It has been suggested by one study, than an area of work surface of at least 100% greater than with typical typing work needs to be dedicated to the job when VDTs are used, unless all transactions are paperless (Slovak and Trevors 1988).

10.3.7 Despite the health symptoms not showing any statistically significant change between the two stages, it is a matter for concern that the overall level of symptoms being reported are so much higher than three of the four DSS sites. These levels of discomfort and ill-health are similar to some reports for other traditional office workers but higher than others. The respondents' views may be influenced by their feelings about their job characteristics and job satisfaction.

10.3.8 The small non-significant increase in the level of stress between the two stages of the study is an important finding, particularly as there was every possibility of an increase in anxiety levels during a period of uncertainty. If there are outcomes which are important to the individual then stress is highest for those who perceive that they are

uncertain about the outcomes, winning or losing (Schuler 1980). The enquiry into the manning levels at DSC, which occurred between the two administrations of the questionnaire, had the possibility of placing these respondents in that position.

10.3.9 The reactions to the office environmental noise were not as adverse as found in some studies, particularly bearing in mind that these users work in an open plan office (Hedge 1986; Sundstrom 1986). The scores however were higher than the DSS sites. Distractions or interruptions in their work by telephones or conversation was 18.7% to 25.0% at DSC. Also disturbance at this site from office machines was also much higher 15.0% to 18.7%, due to a telehoist which carries books and journals to various parts of the building passing close to the sections.

10.3.10 The lighting levels are satisfactory for almost 40-43%, so could be improved for just over half of the respondents, with just under a half finding that reflections and glare are a problem. The findings reflect a poorer situation than at the DSS sites, though no measurements were made of the lighting levels in working areas at any of the sites for this study. Examination of the lighting levels, in conjunction with examination of the glare and screen angle (paragraph 10.3.6), may also contribute to reducing the high levels of reported eyestrain at this site; 47.5% at Document Supply Centre compared with 20% and 35% at the three of the DSS sites.

10.3.11 The findings indicate that the respondents at this

site also have to contend with annoyance and dissatisfaction, which may well contribute to their levels of stress and ill-health. Generally, however, there was found to be reasonable levels of job satisfaction, and not undue levels of stress, during the period of the survey. With enhancement of the system's performance, and careful consideration of the job characteristic issues, a contribution could be made towards further improvements in the staff's attitudes to their jobs.

Summary

10.3.12 This site was selected as acomparison for the measures to ascertain if they indicated stability over the periodof the survey when no major change took place in the organisation. There were minor changes in the perception of the office environment over the two stages; a single variable, the temperature varies, had a significant change. Otherwise there was no statistically significant change found on the other major variables.

Diagram 10.1

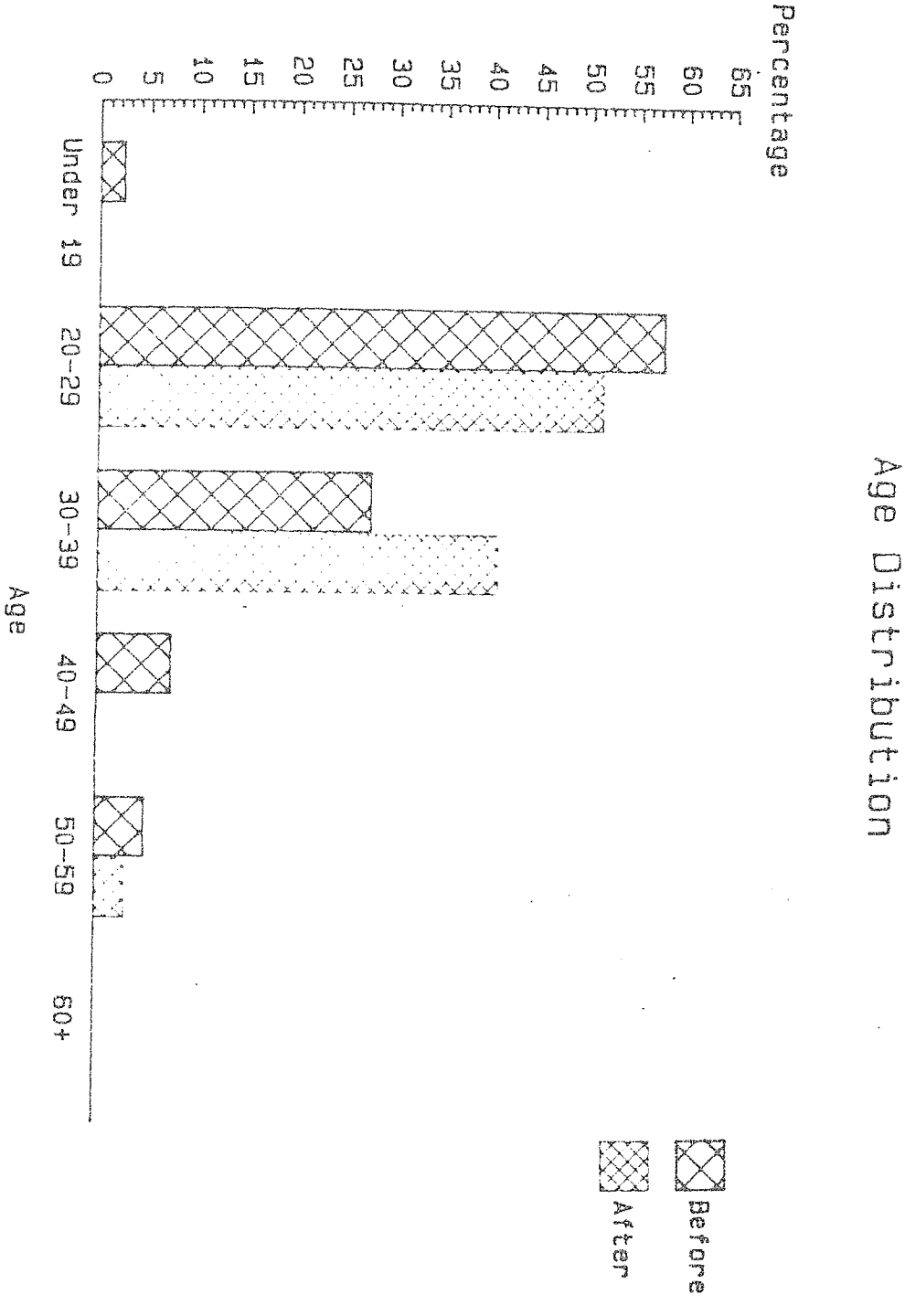

Age Distribution
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Under 19
20-29
30-39
40-49
50-59
60+
Age
Before
After

Diagram 10.2

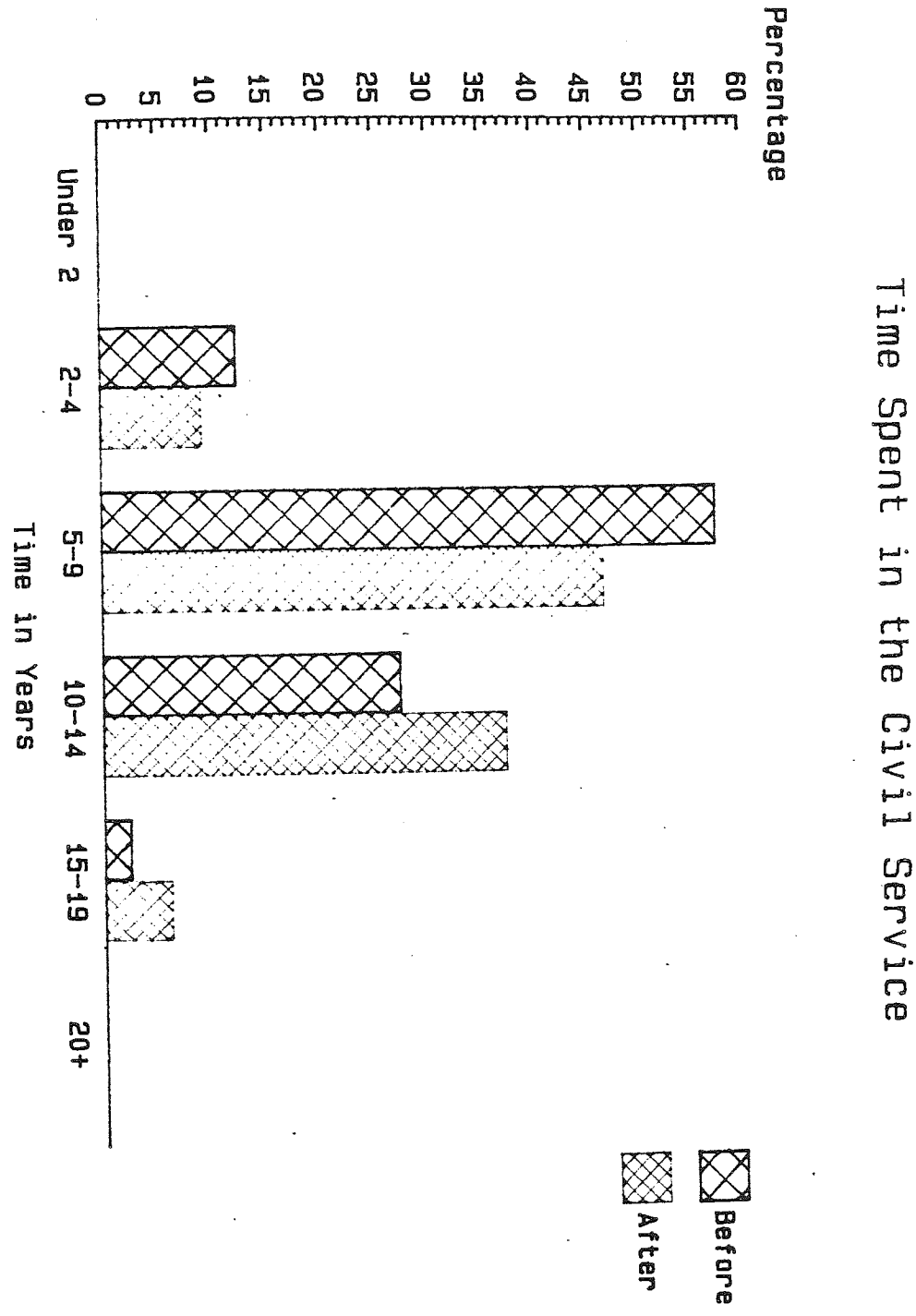

Time Spent in the Civil Service
Percentage
0
5
10
15
20
25
30
35
40
45
50
55
60
Under 2
2-4
5-9
10-14
15-19
20+
Time in Years
Before
After

Diagram 10.3

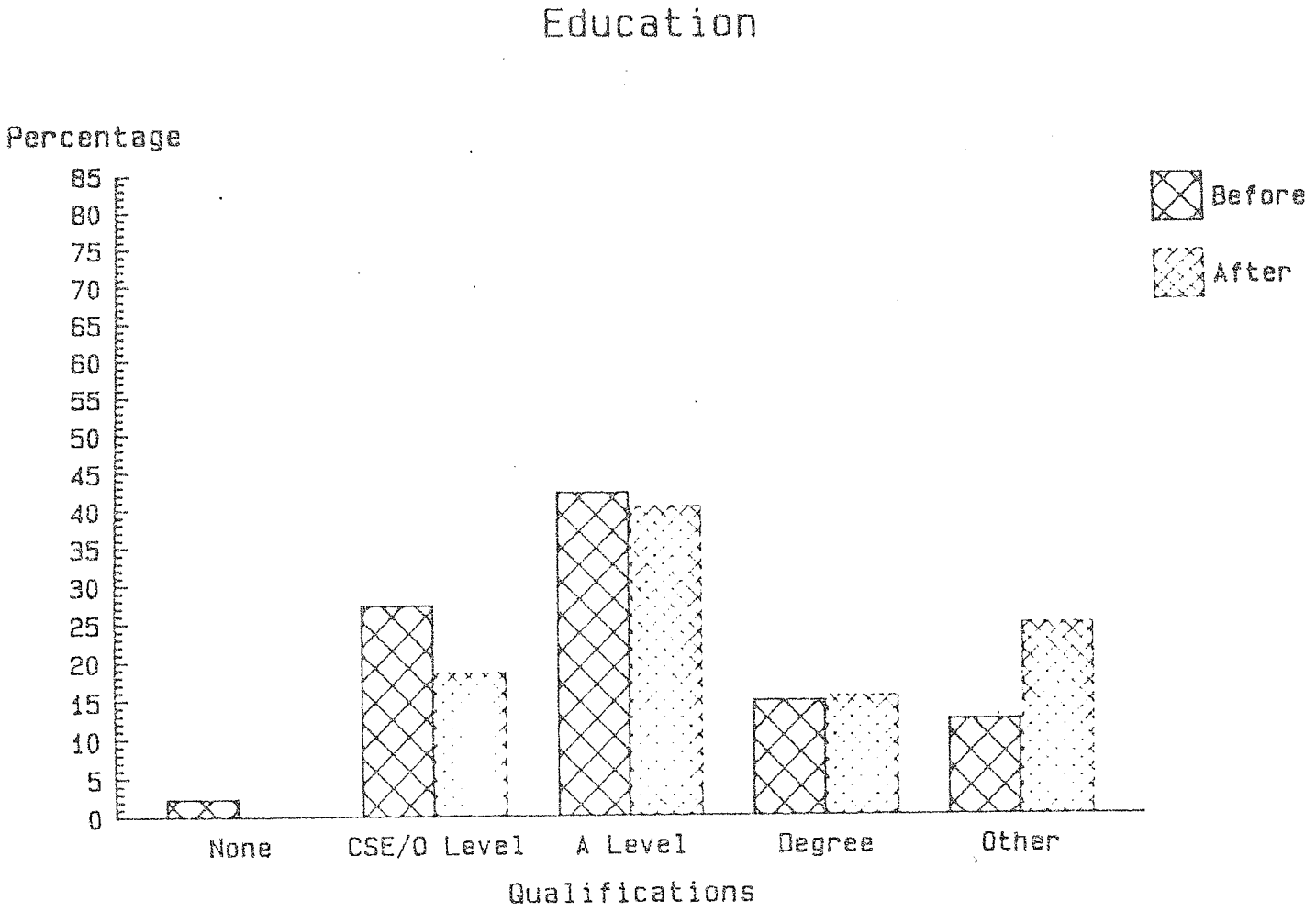
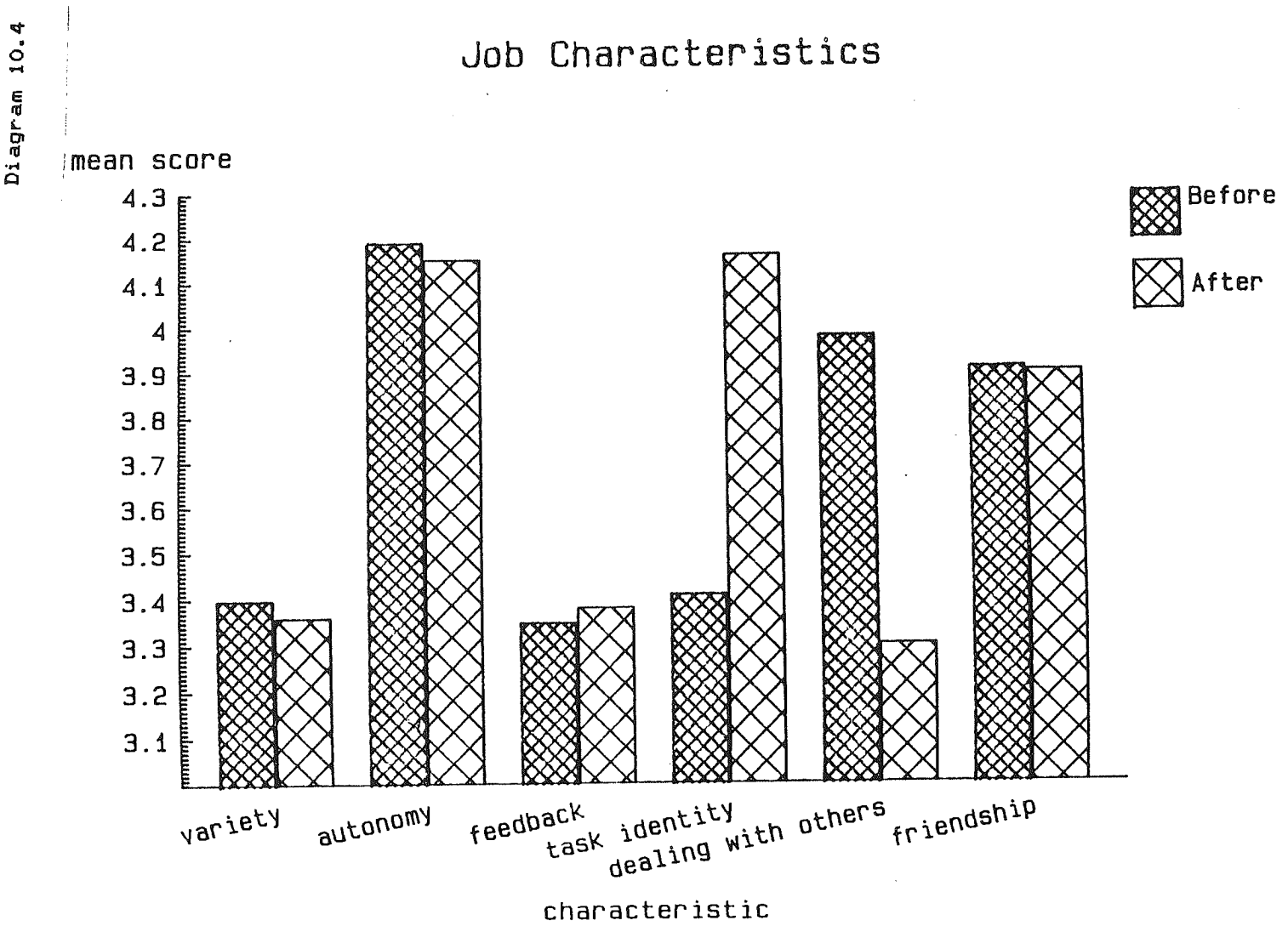

Education
Percentage
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Before
After
None
CSE/O Level
A Level
Degree
Other
Qualifications

Diagram 10.4


Job Characteristics
mean score
4.3
4.2
4.1
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
Before
After
variety
autonomy
feedback
task identity
dealing with others
friendship
characteristic
(maximum score : 5)

11 CASE STUDY INTEGRATION

Chapter Summary

The findings from the individual sites are brought together. The diversity found between the sites on some of the dimensions and the commonalities between the users of the VDTs are examined and drawn out.

11.1 INTRODUCTION

11.1.1 The main idea in this chapter is to draw out the common points between the sites, and whilst doing that, it will be useful to see which are the site differences. Initially the amount of time users spend on the VDT is described and the user's views about their computer system (Section 11.2), how it is seen to both assist and to hinder the workers in their tasks. This is followed by section 11.3, where the findings on the users' perceptions of their job characteristics are discussed, section 11.4 focusing on the level of job satisfaction found among the users, and 11.5 on the health complaints. Finally the diverse data on the views about the office environment is summarised in section 11.6.

11.2 THE USER AND THE MACHINE

11.2.1 The sites can be separated into three groups by distinction of the different functions that the systems were designed to meet. The most diverse and complex functions were provided for the use of a wide range of users in terms of grade and job task at the Regional Directorate Headquarters

and the Office of the Chief Adjudicating Officer. Even though the two computer systems were supplied by different manufacturers they were designed to provide the wide range of office support systems that are becoming commonplace in many modern offices today; word processing, data base, spreadsheet, and communications facilities. The second category is a less comprehensive set of functions provided by the computer, generally referred to in the literature as an interactive system., They are a powerful and important tool for the user, particularly when compared to the manual methods that were being used prior to the introduction of the computers at the Overseas Group Pension office Minimal functions were provided on the small number of workstations at the Child Benefit Centre and restricted the users to a very limited interrogation and printout facility.

11.2.2 There was found to be a considerable range of the time spent by users at the VDT in any one day. As a site CHBC had the smallest amount of daily use. This is due to firstly, the limited function of the system assisting with only a portion of the AAs' total task, secondly, the limited ratio of VDTs to users. The OG site had two distinct groups of users, mainly distinguished by the section that they worked in. Out of the 32 users in the Awards section, who are shown as using the VDT, there were 27 who felt that the system did not afford a great deal of assistance, due to its very simple functions, so they did not use it directly. They requested the documents that the computer produced from the AA clerks. Besides the very limited function, a second disadvantage was that there were only 4 terminals shared by the 110 clerks in the section.

11.2.3 The functions of the system at RD and OCAO were much wider, but even at these sites, after 12 Months of using the VDTs, there were approximately 50% who used their VDT more than 1 hour a day. Overall, there were very few users, under 10% , who spent more than 4 hours a day on the VDT. Table 11.1 sets out the distribution of the amount of time reported by the users that they spend on average in a day at the VDT.

Table 11.1 The amount of time spent by the users at the VDT on an average day

	Number	Percentage
Less than 1 hr	133	49.4
1-2 hrs	68	25.3
3-4 hrs	46	17.1
5-6 hrs and over	22	8.2
Total	269	100.0

11.2.4 There was a high incidence of the users, at all the sites, who found the messages and commands on their respective systems were either satisfactory or more than satisfactory. The "messages being clear" was relatively less positive a view at OG, 65% satisfactory, whilst between 85% and 88% of the users at the other sites indicated satisfaction. A slightly different pattern was seen between the sites for the response to the satisfaction with the commands, OCAO indicating less satisfaction than the others, but the incidence of those who were satisfied was somewhat lower, ranging from 69.7% to 82.9%

11.2.5 With the exception of OCAO, more than 75% thought that the computer was of assistance to them, with OG and RD users

the most satisfied. The lower levels of satisfaction at OCAO was probably due to some frustration that emerged among the users because the major data base function was not set up at the outset. There was considerabe delay and this was thought by the users to be potentially the most advantageous of the computer tools.

11.2.6 The less complex systems at CHBC and OG were found to be the easier systems to learn with 79% and 81.7% finding it so, whilst 72.2% of RD users were finding that they had no problems learning the system. There were clearly more difficulties at OCAO because only 51.5% found their system easy to use, yet the initial training at these two sites was identical and OCAO actually had more trainer days of on-site support following the basic training sessions. The reasons for this difference were not pursued. There may have been two influence on the users' perceptions; one, the application of different software packages, and two, the lack of satisfaction at OCAO with the functionality of the system.

11.2.7 Fewer respondents in this survey reported problems with brightness, glare or screen contrast than in other studies, which found between 30% and 60% of the users were having difficulties with these aspects of the VDT (Hultgren and Knave 1974, Laubli et al 1980 , Dainoff 1982, Rinalducci 1983). These difficulties were negligible at OCAO, varied between 8.5% and 15% at RD and CHBC, with the highest incidence occurring at OG in respect of glare (29%) with brightness and contrast (21% and 19% respectively), also exceeding the levels at the other sites in this survey.

11.2.8 The major dissatisfaction, however, was the

reliability of the computer and the system response times. Breakdowns experienced at RD and OCAO were very infrequent but the majority of CHBC and OG users were particularly troubled by the systems not functioning; 87.8% and 76.0% respectively reporting that breakdowns occur"often". This was not assisted by the poor service that they received,a little over half of the respondents at CHBC (53.7%) thought that it was inadequate and 27% at OG. In contrast, the SRT was the main aspect of dissatisfaction with the performance of the computer at the other sites; 77.8% at RD and 54.5% at OCAO finding that it was a regular problem. The contrast in performance could have been due to the two larger systems at CHBC and OG working from a large central machine, with many other applications and many users from other locations using it. This leads to the potential for malfunction being much greater and, due to the systems support staff not being on site, the level of service and support is viewed in an indifferent light. On the other hand, the smaller pilot systems at OCAO and RD had on site support from systems managers and each had a manufacturer who wished to impress their customer, in view of the potential for future business, so provided a high level of support. This was countered, however, by the greater complexity of the software and the smaller size of the machines which may have been contributory factors in the poor system response times that were experienced.

11.3 THE JOB CHARACTERISTICS,JOB SATISFACTION AND PARTICIPATION VARIABLES

11.3.1 One of the main purposes of the study was to evaluate the level of the users' perceptions of their job

characteristics, job satisfaction and the amount of participation that they felt they had in the decision making processes concerning matters relating to their jobs. As with other studies in this area of research, there were links found between the variables. These office workers, both managers, administrators and clerks, show an increase in their levels of job satisfaction the longer they have been in their careers. However, with the exception of the typist/secretary group, the lower grade workers report less job satisfaction. It was also found that the more senior job holders, and those who have been in the civil service for a greater length of time, see their jobs as having more variety and consider that they have a greater degree of participation in decision making, which replicates the results obtained by Katz (1978).

11.3.2 There was also an effect of the level of educational qualifications at CHBC and OG on how the amount of feedback in the job was seen; the respondents with the higher qualifications, considered that they received more feedback. The other two sites registered that the workers with the higher educational qualifications had more autonomy, dealing with others (OCAO), and friendship (RD).

11.3.3 CHBC was the only site where there was found to be a difference between the males and females on the job satisfaction measure; the male respondents had significantly higher scores than the females. Similarly the male workers at OCAO had higher scores for the variety and friendship measures, though this result is likely to have been confounded by the disproportionate number of males in the senior grade jobs.

11.3.4 In the comparisons made between the pre and post-implementation job characteristic scores, there were none which showed a significant change when the respondents who completed the questionnaires at both stages were considered. This was almost the case for the comparison made between the total number of correspondents at both stages, with the sole exception of OG on the task significance characteristic.

11.3.5 CHBC was the only site where the job satisfaction score changed between the two stages and the OG participation score; there was a small increase at the post-implementation stage in both instances.

11.3.6 One must conclude that the impact of the computer systems on the user's perceptions of their job characteristics, job satisfaction, and participation had not been very large and only a few of the scores which had changed were statistically significant. This finding is in contrast, for instance, with the results obtained in a detailed study of manager's tasks (Bjorn-Anderson et al 1986). These authors found, in their extensive European study, that the changes which occurred in the manager's jobs they examined, were the most widespread of the changes which they found. The difference in this overall conclusion with the findings in this study could be due, on the one hand to their different methodology, which was an integration of questionnaire and structured interviews, and on the other hand, to the types of data they obtained, which was not restricted purely to attitude measures. Their data was concerned with the micro-analysis of the managers jobs and not measures ascertaining attitudinal perceptions about the

"bundles" of tasks that constitute a job. A further important factor is the small amount of time spent by almost half the users actually using their VDT; though the two sites where the computer was introduced for multi-purpose use, also did not show any marked differences in the impact of the VDTs upon the users attitudes.

11.4 THE USER'S HEALTH AND STRESS

11.4.1 The analysis of the responses to the Health Symptom Inventory presented a picture which appears to be influenced by the moderating factor of the different sites and different job levels. The level of discomfort reported by the respondents as occurring at frequent intervals, ranging from "often" to "always", is highest on all the symptoms but three at CHBC and OG (for details see Table 7.13). OG has the lowest incidence of headaches and had almost no reports of swollen joints, as is the case at OCAO. CHBC was found to have nobody who reported a loss of feeling in their fingers, though this was the case at RD and with very small incidence at the other two sites.

11.4.2 The overall level of symptoms at CHBC and OG are comparable to the incidence of similar symptoms found in other studies. There were only a few symptoms which were found to have increased in frequency between the two stages at two of the sites, OCAO and RD having no differences that were statistically significant. The fact, that the Mann-Whitney U Test found that there was a difference between the two stages at CHBC in respect of "changed colour vision", and "stomach pains" at OG, can be discounted due to there only being one

person in each instance who reported this problem, and they did not complete the questionnaire at both stages.

11.4.3 There was found to be a consistent trend across the sites of the female respondents reporting a higher incidence of some health symptoms than the males. A summary is given below of the symptoms by site where the females were found to be reporting significantly higher incidence at each site:-

	CHBC	OG	OCAO	RD
Eyestrain	*			*
Blurred vision				*
Neck pressure	*			
Stiff neck	*			*
Sore shoulders	*			
Swollen joints		*		
Sore wrists			*	*
Headaches	*	*		*

The female respondents suffered more frequently than males; suffering from headaches at three of the sites, with eyestrain, stiff neck, and sore wrists showing similar significant differences at two sites.

11.4.4 Dichotomising the respondents, into high and low scorers on the job satisfaction and stress measures, produced a number of instances where the low job satisfaction and the high stress scorers had a significantly greater incidence of some of the symptoms. It would appear at CHBC that if you are a female, feeling that you have both low job satisfaction and high levels of stress, you are likely to suffer from eyestrain and neck pressure, though this combination did not reveal

itself at the other sites. Irritated eyes were found to be more of a problem for the low job satisfaction scorers at three sites (CHBC, OG, OCAO). The significant differences between these comparison groups was not found for any other symptoms than those indicated above at more than one site.

11.5 THE RELATIONSHIP BETWEEN THE ATTITUDE VARIABLES AND WORKING WITH THE VDTS

11.5.1 Almost 50% of the VDT users at the four sites used the system for less than one hour a day. Previous studies have indicated that it is the more regular users that have complained about increased poor health, reported greater degrees of stress, and experienced diminished job profiles. Because of this, the analysis examined the relationship between the use of the VDT, the views of the system and the attitude variables. There were significant differences between the high and the low user groups at OG, and OCAO, but only relating to their views of the office environment. Both of these findings, however, could be confounded by the location of the majority of the low user group at OG in a different building than the high users, and in the case of the OCAO groups there was a significant difference in their age and job level. The level of use at CHBC was very small with 98.8% using the VDT for less than 2 hours a day so the dichotomised analysis was not applied to their responses.

11.5.2 The only difference, in the reporting of the incidence of ill health symptoms, between the low and high user groups was at RD. There were no other differences between these two groups. The higher users reported differences in the level of

health symptoms relating to visual symptoms (eye strain, irritated and burning eyes) and "back pain".

11.5.3 The scores for the job satisfaction measure were dichotomised between the high and the low scorers. The low job satisfaction scoring users were found to have more perceived problems with breakdowns and the servicing of the system than the higher scorers at CHBC and OG. The only feature of the VDT that the low job satisfaction group considered to be more unsatisfactory, than the high job satisfaction group, was the lack of clarity of the screen characters at CHBC. Both at CHBC and OCAO the high job satisfaction group thought more positively of the assistance that the system gave them, and OCAO high scorers thought that it was more businesslike than the low, scorers.

11.5.4 The differences between the high and low stress groups occurred on more variables at CHBC than at the other sites. This was a strong reflection of the greater overall level of dissatisfaction and stress at this site. The users indicating higher levels of stress found a greater number of problems than the low stress group; the distance to the screen, the documents that they work with as well as the screen characters lacking clarity, generally seeing the system as tiring to use, the system not being of much assistance or help, and suffering from breakdowns. The relationships were not as evident at the other sites. The high stress group at OG thought the number of breakdowns occured more frequently and the servicing was unsatisfactory to a greater extent than the low stress group, whilst it was the brightness and angle of the screen at OCAO that was significantly different for the high stress group.

11.6 THE OFFICE ENVIRONMENT

11.6.1 The previous research into the effect of the office environment indicates that there are a number of parameters which have been found to produce negative reactions by the office worker to their surroundings; among them are the level of illumination and noise, the comfort of the ambient temperature, and particularly with regard to the use of VDTs, the comfort and characteristics of the workstation. The responses to the questions on the office environment were summarised in each case study, and even though the ambient environment was supposedly being maintained at an acceptable" level for the office workers, adverse reactions were still substantial at most of the sites. The respondents at RD were the least satisfied with the comfort of the temperature, whilst at the other sites those regarding the temperature as comfortable was approximately 40%. The reasons for the lack of comfort with the temperature was inadequate air movement at two sites, and at all the sites there was over 60% who found the ventilation unsatisfactory. The reaction to their surroundings was also reflected differently at CHBC and OG by the respondents in the different buildings that they were located in at each site. The comparison of the data, for any differences between the scores obtained at the two stages of the survey, found a few items which had changed significantly at only two of the sites; the comfort of the temperature had deteriorated at OG, and more considered that it was too warm at RD.

11.6.2 The lighting was satisfactory for a large majority at both OCAO and RD, but it was only a little over half of the respondents who thought that the lighting was satisfactory at CHBC and OG. There was approximately 30%-40% who had experienced problems with reflections and glare at three of the sites; whilst it was very much a minor problem at RD (10%-13%). Both sets of findings, however, are below the level of dissatisfaction that other studies have found (eg 70%-80% - Stammerjohn et al 1981). There were no significant differences found between the two stages of the survey on these items at three of the sites. The improvement at OCAO in the incidence of satisfaction with the lighting of almost 30% was probably due to the uplift in the lighting equipment which took place at the time of the introduction of the VDTs.

11.6.3 Despite the incidence varying between the sites, the category of noise that was reported as most frequently disturbing people in their workplace, was from the internal office distractions of telephones and colleagues talking. The highest level of distraction was reported by the OCAO respondents at the pre-implementation stage (46.9%), but this dropped to approximately the same level as RD and OG reported at the post-implementation stage. Despite the AAs at CHBC expressing very much higher levels of dissatisfaction with the other office environmental variables, they experienced a very low level of distraction from internal office noise (4.9% at Stage 2), which is probably a reflection on the low levels of concentration required in their jobs. The levels of internal distractions were found to be much higher in previous studies, between 45% and 61% (Stewart 1980, Cane et al 1984, Hedge 1986, Sundstrom 1986).

11.6.4 The external noise was regarded as a problem by the staff at OCAO (32.3% at Stage 2), probably due to the location of the office on a very busy city road,and the user's rooms had no double glazing. This contrasts with the relatively minor number at RD who found the external noise distracting (7.5% at Stage 2), and who occupied rooms with double glazing and on floors at higher levels above an extremely busy main road route in central London. At none of these sites was there a problem for more than about 6.0% of the respondents from office machines. The introduction of the VDTs had not changed that position, except at OG where statistically significant changes were found, but the incidence was not very large even at Stage 2 2.4%). A similar comment can be made about the reduction found in the number reporting problems with the outside noise at CHBC and OG, because despite the change being statistically significant, the percentage reporting the item as occurring "often" was small (between 2.4% and 7.9% respectively).

11.6.5 The discomfort of the chair, and satisfaction with the desk, did not appear to be a problem at OCAO and RD where those reporting satisfaction with the furniture was between 87.1% and 96.8%. This finding was in contrast to the deterioration in the level reporting satisfaction at CHBC and OG, between 57.3% and 65.9% at the post-implementation stage. It was only at OG that the deterioration was statistically significant, and despite the desks conforming to the recommended dimensions (Cakir et al 1980), the VDT limited the space on the desk surface available for working with papers.

12. CHANGES OVER TIME

Chapter Summary

The data analysis compared the results obtained at the pre-implementation survey with those from the post-implementation survey. The results of the comparison are described. In addition the data obtained from control groups of respondents was analysed

12.1 INTRODUCTION

12.1.1 An important focus of the analysis of the survey's data is the nature and extent of any changes in the variables that have taken place between the two data collection points; in particular the health symptoms, stress, job satisfaction, participation in decision making and the job characteristics. The recording and description of the findings for the individual sites examined on an individual basis the comparisons between the two stages so the interest of this section of the analysis will be the comparisons of the aggregated data from the DSS sites. In consideration of the delays at OG in the date of implementation of the on line system and the consequent disruption of the collection of the stage two questionnaires the data was aggregated for the three sites excluding OG, ie CHBC, OCAO, RD. However it was considered of interest to also aggregate the data for the four sites and examine for differences and thereby gain the advantage of a larger sample, but bearing in mind the possible differences found in the analysis between the two aggregations could be due to different time spans between the data

collections. In addition the analysis took account of two groups of respondents:

a. all respondents who completed the questionnaires;

b. the respondents who completed the questionnaire at stage two who had done so at stage one.

12.2 COMPARISONS OF "BEFORE" AND "AFTER"

12.2.1 A number of t-tests for differences in means were performed. Table 12.1 and 12.2 present the comparison data for both groups of sites. There was found to be only one significant result from either of the site aggregations. The amount of participation had been perceived to have increased for the respondents who had completed the questionnaire at both stages at the four sites; a mean score increase from 15.52 to 16.23 ($t=2.24$, $P<.05$). Stress had decreased across the three sites but at a significant level only for the comparison of all respondents (26.93 to 25.13, $t=2.13$, $P<.05$). The stronger result would have been to have found the significant change occurring for the respondents who completed the questionnaire at both stages. The significant difference in the scores could possibly be due therefore to the demographic differences in the two sample populations at the second stage completion. No differences were found for the other variables. The perception of their jobs by the VDT users doesn't seem to have been altered by the introduction of the technology.

Table 12.1. Comparison of the mean scores on the JCI and Attitude variables between the pre and post-implementation stages for 4 sites (CHBC, OG, OCAO, RD)

		Stage 1		Stage 2				
		Mean	SD	Mean	SD	T	df	P
Variety	1	3.25	.67	3.21	.62	.73	632	.47
	2			3.24	.57	.20	476	.84
Autonomy	1	3.83	.56	3.81	.56	.38	622	.71
	2			3.81	.61	.32	433	.75
Feedback	1	3.52	.68	3.48	.63	.62	631	.53
	2			3.51	.61	.00	454	.99
Dealing with others	1	3.33	.69	3.32	.67	-.01	628	.99
	2			3.36	.63	-.65	455	.51
Task significance	1	4.00	.74	3.89	.76	1.74	619	.08
	2			3.97	.67	.35	460	.73
Friendship	1	3.55	.57	3.58	.58	-.71	620	.48
	2			3.60	.56	-1.15	428	.25
Stress	1	25.87	7.4	25.32	7.12	.95	627	.35
	2			25.47	7.25	.64	428	.52
Participation	1	15.52	4.00	15.98	3.50	-1.57	636	.12
	2			16.23	3.43	-2.24	470	.03*
Job satisfaction	1	57.78	13.17	58.07	12.17	-.29	630	.77
	2			57.74	12.67	.01	437	.99

1 N for all respondents = Stage 1: 342; Stage 2: 296
2 N for respondents who completed at both stages = Stage 1: 342; Stage 2: 202
* P<.05

Table 12.2. Comparison of the mean scores between the pre and post-implementation stages on the JCI and Attitude Variables for 3 sites (CHBC, OCAO, RD)

		Stage 1		Stage 2				
		Mean	SD	Mean	SD	T	df	P
Variety	1	3.16	.78	3.11	.74	.58	345	.56
	2			3.13	.71	.29	213	.78
Autonomy	1	3.80	.62	3.84	.61	-.63	345	.53
	2			3.85	.60	-.66	202	.51
Feedback	1	3.46	.73	3.39	.63	.88	342	.38
	2			3.35	.61	1.18	225	.24
Dealing with others	1	3.32	.74	3.29	.73	.35	345	.73
	2			3.32	.70	-.11	204	.92
Task significance	1	3.77	.79	3.76	.80	.18	344	.86
	2			3.82	.71	-.51	213	.61
Friendship	1	3.52	.58	3.54	.64	-.25	337	.80
	2			3.52	.64	.01	176	.99
Stress	1	26.93	8.25	25.13	7.53	2.13	343	.03*
	2			26.11	8.06	.84	197	.40
Participation	1	16.43	4.39	16.40	3.77	.08	342	.93
	2			16.73	3.84	-.63	218	.53
Job satisfaction	1	55.91	15.31	56.94	13.26	-.63	339	.53
	2			55.49	14.58	.23	204	.82

1 N for all respondents = Stage 1: 177; Stage 2: 169
2 N for respondents who completed at both stages = Stage 1: 177; Stage 2: 96

* P<.05

12.2.2 The amount of time spent by the users on the VDTs was assessed at 11.2.3 and on the whole was not very great. The amount of use varied between sites, in particular with CHBC and Group 2 at OG spending relatively little time on the VDT. In other studies (eg Dy 1985, Evans 1985) it has

Table 12.3. Comparison of the mean scores between the respondents who use the VDT less than 1 hour a day and those who use it 2 hours or more a day for the 4 sites

	Under 1 hr (N=133)		Over 2 hrs (N=163)				
	Mean	SD	Mean	SD	T	DF	P
Variety	3.18	.65	3.24	.61	-.76	273	.45
Autonomy	3.87	.50	3.76	.60	1.82	293	.07
Feedback	3.52	.58	3.46	.67	.87	293	.38
Dealing with others	3.29	.63	3.36	.70	-.90	291	.37
Task significance	3.91	.67	3.88	.82	.30	294	.77
Friendship	3.62	.54	3.55	.61	1.04	291	.30
Stress	26.25	7.45	24.57	6.77	2.00	265	.046
Participation	16.20	3.35	15.80	3.61	.98	289	.33
Job satisfaction	56.02	12.58	59.74	11.58	-2.63	271	.009

generally been the workers using the VDT for long spells that have been found to have the poorer job profiles, most stress, and the lowest job satisfaction. The respondents from the four sites were divided into lower and higher users and the groups mean scores compared for the attitude and job characteristic variables. Tables 12.3 and 12.4 present the comparisons for users under one and over two hours a day and those under two and over three hours. The job satisfaction scores for both comparisons is greater for the more regular users ($t=2.63$, $P<.01$, $t=-2.20$, $P<.05$), whilst stress is less, though only significant for the first comparison ie under one and over two hours ($t=2.0$, $P<.05$, and $t=1.12$, $P<.05$). Variety was the only

dimension of the job perceptions found to be significant (t=-2.93, P<.01); the higher users having the greater variety score.

Table 12.4. Comparison of the mean scores between the respondents who use the VDT less than 2 hours a day and those who use it more than 2 hours a day for the 4 sites

	Under 2 hrs (N=201)		Over 3 hrs (N=95)				
	Mean	SD	Mean	SD	T	DF	P
Variety	3.15	.68	3.35	.47	-2.93	253	.004
Autonomy	3.81	.55	3.80	.60	.19	169	.85
Feedback	3.50	.62	3.45	.67	.64	171	.52
Dealing with others	3.30	.67	3.39	.66	-1.15	187	.25
Task significance	3.83	.76	4.01	.75	-1.91	185	.06
Friendship	3.58	.60	3.58	.54	.11	203	.92
Stress	25.63	7.29	24.66	6.74	1.12	198	.26
Participation	15.97	3.48	16.01	3.57	-.09	179	.93
Job satisfaction	56.99	11.95	60.34	12.36	-2.20	179	.03

12.3 HEALTH ISSUES

12.3.1 A common theme in the findings of previous studies has been the reported higher incidence of ill-health among the users of VDTs (eg Cakir et al 1980, Grandjean 1987). The t-test data comparing the mean scores for the 19 ill-health symptoms reported at both stages is shown in Table 12.5 and Table 12.6. No statistically significant differences were

found between the stages for either the three or four site aggregated data or the two sets of respondents.

12.3.2 The most frequently reported health complaints of VDT users have been associated with vision. This has been related to deficiencies in the visual environment which can be caused by the VDT itself, the office environment, or some attribute of the operator (Boyce 1981a). The aspect which causes the most trouble is the deterioration in the eye's accommodation with age. To correct this glasses are worn but these allow only a limited range of focussing. At all the sites the employees were given the opportunity to have their eyes tested before they began to use the VDT. In order to examine whether there were any differences in the reported health symptoms between the users wearing spectacles and those not a t-test was performed on the Health Symptom Inventory, the attitude variables and the variables relating to the VDT and computer system characteristics. The results are shown in Table 12.7 for the attitude variables and the health symptoms found to be significant. The direction of the difference in the means is consistent for all the variables in the table indicating that the users with glasses have less trouble with irritated eyes, problems with the brightness of the screen, less shoulder and neck aches, as well as more job satisfaction.

Table 12.5. **Comparison of the health symptoms mean scores between the pre- and post-implementation stages for the three sites (CHBC, OCAO, RD)**

		Stage 1		Stage 2			
		Mean	SD	Mean	SD	T	DF
Eyestrain	1	2.33	1.09	2.30	1.17	.25	338
	2			2.32	1.16	.11	182
Stiff neck	1	2.15	1.12	2.26	1.23	-.86	334
	2			2.28	1.25	-.88	176
Burning eyes	1	1.60	.88	1.65	.98	-.56	332
	2			1.75	1.02	-1.19	169
Sore shoulders	1	1.76	1.05	1.83	1.09	-.56	337
	2			1.87	1.11	-.78	183
Back pain	1	2.09	1.18	2.20	1.11	-.86	340
	2			2.21	1.23	-.73	186
Irritated eyes	1	1.87	.92	2.01	1.01	-1.31	333
	2			2.08	1.05	-1.68	173
Blurred vision	1	1.52	.86	1.56	.85	-.43	340
	2			1.63	.90	-.99	186
Stiff arms	1	1.35	.68	1.44	.79	-1.14	327
	2			1.42	.72	-.74	182
Stiff legs	1	1.38	.78	1.42	.79	-.46	339
	2			1.35	.67	.39	22
Neck pressure	1	1.77	1.02	1.79	1.06	-.21	338
	2			1.85	1.10	-.63	181
Skin rash	1	1.17	.51	1.19	.59	-.35	329
	2			1.20	.63	-.45	163
Stomach pains	1	1.23	.51	1.20	.55	.62	335
	2			1.26	.62	-.39	163
Swollen joints	1	1.18	.64	1.20	.60	-.33	340
	2			1.21	.58	-.36	210
Hand cramps	1	1.34	.67	1.31	.69	.40	338
	2			1.38	.79	-.44	167
Changed colour vision	1	1.08	.29	1.04	.23	1.33	329
	2			1.06	.29	.46	197
Fainting	1	1.05	.29	1.04	.19	.58	301
	2			1.04	.20	.31	251
Feeling loss in fingers	1	1.07	.28	1.09	.34	-.47	321
	2			1.14	.43	-1.28	139
Headaches	1	2.26	.96	2.32	1.08	-.56	331
	2			2.44	1.16	-1.33	165

1 Respondents N = Stage 1: 178; Stage 2: 169
2 Respondents who completed the questionnaire at both stages
N = Stage 1: 178; Stage 2 = 96

Table 12.6. Comparison of the health symptoms mean scores between the pre- and post-implementation stages for the four sites (CHBC, OG, OCAO, RD)

		Stage 1		Stage 2			
		Mean	SD	Mean	SD	T	DF
Eyestrain	1	2.34	1.08	2.24	1.06	1.21	622
	2			2.23	1.06	1.17	424
Stiff neck	1	2.11	1.04	2.20	1.12	-1.03	601
	2			2.20	1.12	-.98	393
Burning eyes	1	1.63**	.93	1.69	.96	-.85	613
	2			1.73	.97	-1.21	408
Sore shoulders	1	1.75	.97	1.82	1.00	-.93	612
	2			1.84	.98	-.10	412
Back pain	1	1.94	1.05	2.08	1.04	-1.65	621
	2			2.06	1.08	-1.27	412
Irritated eyes	1	1.95	.98	1.98	.97	-.38	619
	2			2.02	.99	-.80	413
Blurred vision	1	1.55	.90	1.48	.78	1.04	631
	2			1.48	.78	1.00	468
Stiff arms	1	1.31	.64	1.36	.70	-.96	600
	2			1.32	.64	-.29	419
Stiff legs	1	1.42	.76	1.42	.77	-.07	617
	2			1.38	.70	.56	448
Neck pressure	1	1.74	.97	1.78	.99	-.56	615
	2			1.81	.99	-.78	412
Skin rash	1	1.19	.52	1.21	.59	-.29	590
	2			1.22	.63	-.52	363
Stomach pains	1	1.19	.44	1.22	.51	-.78	584
	2			1.24	.53	-1.18	366
Swollen joints	1	1.16	.54	1.21	.59	-1.16	598
	2			1.23	.60	-1.45	383
Hand cramps	1	1.44	.70	1.43	.71	.23	617
	2			1.47	.74	-.48	403
Changed colour vision	1	1.07	.28	1.06	.27	.71	623
	2			1.07	.29	.16	410
Fainting	1	1.04	.24	1.02	.15	1.10	583
	2			1.02	.16	.96	533
Feeling loss in fingers	1	1.08	.33	1.11	.35	-.74	606
	2			1.13	.39	-1.33	364
Headaches	1	2.33**	.96	2.36	1.02	-.35	607
	2			2.38	1.03	-.64	397

NB: 1 All respondents N = Stage 1: 342; Stage 2: 296
2 Respondents who completed the questionnaire at both stages N = Stage 1: 342; Stage 2 = 202

Table 12.7. Comparison of the mean scores between the respondents who wear glasses and those who do not at the post-implementation stage (significant results: P<.05)

	With glasses (N=104)		Without glasses (N=190)				
	Mean	SD	Mean	SD	T	df	P
Job satisfaction	60.64	12.46	56.68	11.80	2.66	201	.008**
Stiff neck	1.97	1.04	2.32	1.15	-2.66	230	.008**
Sore shoulders	1.66	.90	1.91	1.04	-2.13	239	.034*
Irritated eyes	1.79	.76	2.08	1.06	-2.7	271	.006**
Screen brightness	1.54	.84	1.82	1.00	-2.44	223	.015*
System is tiring to use	2.35	1.05	2.62	1.09	-2.01	199	.045*

* P<.05 ** P<.01

12.4 PREVIOUS VDT EXPERIENCE

12.4.1 The attitude towards computers has been suggested as an important correlate of the users reaction to using VDTs and their decisions about how they want to use them (Rafaeli 1986). It is likely that individuals who have worked with computers will develop a different attitude towards them than the naive user and this could in turn affect their perception of their job after computers have been introduced. A study of professional users found the experienced user more positive in their attitudes than the inexperienced (Zoltan and Chapanis 1982) and a survey of secretarial staff found less anxiety and a more positive attitude towards the capabilities of word

processors from those with previous experience of word processors than#those without (Arndt et al 1983).

12.4.2 The data from the current survey was examined to see if there was any difference between the groups who had had previous experience with computers at home, work, or in their education. Tables 12.8 to 12.10 summarise the t-test comparisons. Only two job characteristic dimensions had statistically significant different mean scores; those who had used a VDT in their education scored less on the variety dimension ($t=-3.62, P<.001$), whilst the group who had not used a VDT at home had a lower score for the dealing with others dimension ($t=3.09, P<.01$). None of the attitude variables were found to be significant. A comparison of the Health Symptom Inventory mean scores found six items which were significant for the previous work users, four for the education users, and one for the home users. The single symptom for the home users group was lower for the user than the non-user whereas for the work and education user groups the users were higher than the non-users on all ten symptoms. With the exception of skin rash all the symptoms were in the visual or musculo-skeletal groups of symptoms.

Table 12.8. **Comparison of the mean scores between the respondents at the post-implementation stage who have not previously used VDTs at work**

	Used VDT (N=81)		Did not use VDT (N=186)				
	Mean	SD	Mean	SD	T	df	P
Variety	3.16	.71	3.21	.61	-.58	135	.29
Autonomy	3.86	.54	3.78	.59	1.07	166	.29
Feedback	3.51	.62	3.47	.64	.55	157	.58
Dealing with others	3.33	.65	3.32	.68	.12	166	.90
Task significance	3.82	.77	3.87	.75	-.50	151	.62
Friendship	3.58	.55	3.57	.61	.12	169	.91
Stress	25.99	6.59	24.94	7.33	1.16	168	.25
Partici-pation	16.20	3.69	16.09	3.36	-1.72	142	.88
Job satisfaction	56.00	13.00	58.89	11.84	.22	142	.83
Eyestrain	2.61	1.16	2.08	.98	3.64	132	.000
Stiff neck	2.59	1.20	1.99	1.06	3.87	136	.000
Back pain	2.47	1.18	1.95	.96	3.50	128	.001
Blurred vision	1.77	.95	1.38	.69	3.27	118	.001
Stiff arms	1.52	.82	1.30	.64	2.16	124	.032
Neck pressure	2.03	1.06	1.66	.94	2.66	137	.009

Table 12.9. Comparison of the mean scores between the respondents at the post-implementation stage who have or have not previously used VDTs in their education

	Used VDT (N=59)		Did not use VDT (N=209)				
	Mean	SD	Mean	SD	T	df	P
Variety	2.91	.69	3.27	.60	-3.62	84	.001
Autonomy	3.78	.65	3.81	.55	-.34	83	.73
Feedback	3.39	.66	3.50	.62	-1.21	89	.23
Dealing with others	3.26	.63	3.34	.68	-.87	98	.39
Task significance	3.77	.86	3.87	.72	-.80	84	.42
Friendship	3.53	.67	3.59	.57	-.56	83	.58
Stress	25.61	7.20	25.16	7.1	.42	92	.68
Partici-pation	15.37	3.71	16.33	3.37	-1.81	91	.07
Job satisfaction	55.39	12.44	58.69	12.14	-1.78	86	.08
Stiff neck	2.61	1.30	2.05	1.06	3.02	81	.003
Sore shoulders	2.10	1.31	1.72	.89	2.11	73	.039
Back pain	2.54	1.17	1.99	.99	3.31	82	.001
Skin rash	1.46	.86	1.15	.51	2.59	69	.012

Table 12.10. Comparison of the mean scores between the respondents at the post-implementation stage who have or have not previously used VDT at home

	Used VDT (N=46)		Did not use VDT (N=220)				
	Mean	SD	Mean	SD	T	df	P
Variety	3.18	.61	3.20	.64	-.25	69	.81
Autonomy	3.83	.52	3.80	.59	.40	73	.69
Feedback	3.53	.61	3.47	.64	.58	69	.57
Dealing with others	3.59	.64	3.27	.66	3.09	69	.003
Task significance	3.85	.70	3.85	.77	-.02	71	.98
Friendship	3.68	.59	3.55	.59	1.40	67	.17
Stress	24.35	7.08	25.45	7.14	-.96	65	.34
Participation	15.77	4.18	16.19	3.23	-.65	58	.52
Job satisfaction	59.36	13.52	57.67	11.99	.80	62	.43
Changed colour vision	1.00	.00	1.07	.31	-3.50	219	.001

12.5 THE INFLUENCE OF JOB LEVEL

12.5.1 The individual site data at OCAO and RD found that there were differences in the job characteristic and attitude variable scores between the job levels (paragraphs 8.2.10 and 9.2.10). A t-test of the mean scores at the two stages between the two groups, managers/professionals and clerks/typists, for all the four sites was completed. At the pre-implementation stage there was found to be significant differences on the variety and dealing with others dimensions of the JCI and the amount of participation and job satisfaction (Table 12.11).

The managers and professionals had the higher scores on these four measures. At the post-implementation stage these four items had been joined by another two, autonomy and stress, the direction of the scores remained the same except for stress which was reversed (Table 12.12).The mean score on the GHQ12 for the clerks/typists lies closer to the mean for the aggregated scores (see Table 12.2) which was the only variable on the attitude and JCI measures to have a significant change for the two stage comparison.

12.5.2 Because of the job level differences an analysis was conducted to examine for any differences between the scores for these same variables at the two stages separating out the managers /professionals from the clerks and typists and the results are shown at Tables 12.13 and 12.14. The participation score for the clerks typists was the single variable that reached statistical significance. It is interesting that OG was the only individual site with a significant change occurring on the participation score for the comparison of the two stages. It indicated an improvement occurring even though the formal mechanisms for participation were not as apparent as at OCAO and RD. The trend at the other three sites, although not statistically significant, indicated a slight improvement in the scores.

Table 12.11. Comparison of the mean scores of the job characteristics and attitude variables (t-test two tailed) for the managers/professionals and the clerk/typists at the pre-implementation stage

	Managers/ professionals (N=83)		Clerks/ Typist (N=257)			
	Mean	SD	Mean	SD	T	df
Variety	3.68	.61	3.12	.63	7.17	142***
Autonomy	3.84	.54	3.82	.57	.26	145
Feedback	3.54	.71	3.51	.67	.32	131
Task significance	3.94	.60	4.02	.79	-.09	180
Dealing with others	3.64	.65	3.23	.68	5.03	144***
Friendship	3.57	.53	3.55	.59	.32	150
Stress	24.93	7.17	26.17	7.49	-1.35	143
Participation	18.81	3.49	14.46	3.50	9.84	138***
Job satisfaction	63.52	12.57	55.93	12.84	4.73	139***

*** P<.001

Table 12.12. Comparison of the mean scores for the job characteristics and attitude variables (t-test two-tailed) for the managers/professionals and clerks/typists at the post-implementation stage

	Managers/ Professionals (N=63)		Clerks/ Typists (N=233)			
	Mean	SD	Mean	SD	T	df
Variety	3.64	.55	3.10	.59	6.81	103***
Autonomy	3.94	.51	3.77	.57	2.27	108*
Feedback	3.46	.55	3.49	.66	-.42	115
Task significance	3.78	.66	3.92	.78	-1.44	114
Dealing with others	3.56	.64	3.27	.66	3.17	101**
Friendship	3.61	.52	3.58	.59	.39	108
Stress	23.25	7.05	25.88	7.05	-2.62	98**
Participation	18.73	3.11	15.24	3.23	7.84	105***
Job satisfaction	63.38	12.23	56.64	11.77	3.91	95***

* P<.05 ** P<.01 *** P<.001

Table 12.13. Comparison of the mean scores for the two stages on the job characteristics and attitude variables (t-test two tailed) for the managers/professionals

	Pre-implementation (N=83)		Post-implementation (N=63)			
	Mean	SD	Mean	SD	T	df
Variety	3.68	.61	3.64	.55	.35	139
Autonomy	3.84	.54	3.94	.51	-1.18	136
Feedback	3.54	.71	3.46	.55	.77	143
Task significance	3.93	.60	3.78	.66	1.47	126
Dealing with others	3.64	.65	3.56	.64	.80	134
Friendship	3.57	.53	3.61	.52	-.45	134
Stress	24.93	7.17	23.25	7.05	1.41	134
Participation	18.81	3.49	18.73	3.11	.14	140
Job satisfaction	63.52	12.57	63.38	12.23	.07	135

Table 12.14. Comparison of the mean scores for the two stages on the job characteristics and attitude variables (t-test two tailed) for the clerks/ typists

	Pre-implementation (N=257)		Post-implementation (N=231)			
	Mean	SD	Mean	SD	T	df
Variety	3.16	.63	3.10	.59	.30	488
Autonomy	3.82	.57	3.77	.57	.94	483
Feedback	3.51	.67	3.49	.66	.31	485
Task significance	4.02	.79	3.92	.78	1.31	484
Dealing with others	3.23	.68	3.27	.66	-.67	485
Friendship	3.54	.58	3.58	.59	-.59	482
Stress	26.17	7.49	25.88	7.05	.43	486
Participation	14.47	3.50	15.24	3.23	-2.55	489*
Job satisfaction	55.93	12.84	56.63	11.77	-.63	486

* P<.05

12.5.3 A similar analysis by job level of the health symptoms found four symptoms at the pre-implementation stage and five at the post-implementation stage which were not significant (Tables 12.15 and 12.16). Three of these non-significant items occurred at both stages; stomach pains, changed colour vision and fainting. There is clearly a strong and consistent difference in the reported ill-health of these two job levels though separate comparisons of the pre and post-implementation scores for the two job level groups found only one significant item,sore wrists,in the managers/professionals group and none in the clerical/ typist

group (Tables 12.17 and 12.18). The underlying causes for these differences is complex and is discussed later.

Table 12.15. Comparison of the mean scores of the health symptoms (t-test two tailed)for the managers/ professionals and the clerk/typists at the pre-implementation stage

	Managers/ professionals (N=83)		Clerks/ Typist (N=257)			
	Mean	SD	Mean	SD	T	df
Eyestrain	1.96	.82	2.47	1.12	-4.42	189***
Stiff neck	1.64	.82	2.26	1.05	-5.58	176***
Burning eyes	1.46	.69	1.68	1.00	-2.29	201*
Sore shoulders	1.41	.75	1.86	1.00	-4.36	184***
Back pain	1.68	.90	2.03	1.08	-2.95	165**
Irritated eyes	1.75	.71	2.02	1.04	-2.64	202**
Blurred vision	1.29	.64	1.63	1.00	-3.80	210***
Stiff arms	1.12	.40	1.37	.69	-4.02	246***
Stiff legs	1.15	.43	1.50	.82	-4.98	270***
Neck pressure	1.46	.72	1.50	1.02	-3.65	196***
Skin rash	1.08	.32	1.23	.57	-2.83	250**
Stomach pains	1.19	.51	1.19	.42	.03	121
Swollen joints	1.04	.18	1.20	.60	-3.79	337***
Hand cramps	1.25	.46	1.50	.75	-3.54	226***
Sore wrists	1.15	.35	1.29	.61	-2.71	243**
Changed colour vision	1.05	.21	1.08	.30	-1.11	193
Fainting	1.02	.15	1.05	.26	-.96	238
Feeling loss in fingers	1.08	.32	1.09	.33	-.03	143
Headaches	1.92	.67	2.46	1.04	-5.69	210***

* P<.05 ** P<.01 *** P<.001

Table 12.16. **Comparison of the mean scores of the health symptoms (t-test two tailed)for the managers/ professionals and the clerk/typists at the post-implementation stage**

	Managers/ professionals (N=83)		Clerks/ Typist (N=257)			
	Mean	SD	Mean	SD	T	df
Eyestrain	1.78	.91	2.37	1.06	-4.41	112***
Stiff neck	1.62	.88	2.36	1.13	-5.48	122***
Burning eyes	1.49	.84	1.75	.99	-2.03	113*
Sore shoulders	1.24	.53	1.98	1.04	-7.79	200***
Back pain	1.60	.79	2.21	1.06	-4.96	128***
Irritated eyes	1.68	.80	2.06	1.00	-3.14	120**
Blurred vision	1.38	.77	1.51	.79	-1.18	100
Stiff arms	1.11	.36	1.42	.74	-4.46	211***
Stiff legs	1.19	.50	1.49	.81	-3.55	159***
Neck pressure	1.40	.64	1.89	1.04	-4.65	162***
Skin rash	1.18	.55	1.21	.60	-.47	104
Stomach pains	1.17	.58	1.23	.49	-.74	87
Swollen joints	1.06	.25	1.25	.64	-3.57	263***
Hand cramps	1.16	.48	1.50	.74	-4.36	150***
Sore wrists	1.05	.22	1.33	.64	-5.69	281***
Changed colour vision	1.08	.33	1.06	.26	.62	84
Fainting	1.02	.13	1.03	.16	-.53	121
Feeling loss in fingers	1.03	.18	1.26	.38	-2.80	222**
Headaches	1.91	.71	2.48	1.05	-5.08	144***

* P<.05 ** P<.01 *** P<.001

Table 12.17. **Comparison of the mean scores of the health symptoms (t-test two tailed) between the two stages for the managers/professionals**

	Pre-implementation (N=83)		Post-implementation (N=63)			
	Mean	SD	Mean	SD	T	df
Eyestrain	1.96	.82	1.78	.91	1.28	126
Stiff neck	1.64	.82	1.62	.88	.14	127
Burning eyes	1.46	.69	1.49	.84	-.26	117
Sore shoulders	1.41	.75	1.24	.53	1.62	143
Back pain	1.67	.90	1.60	.79	.51	140
Irritated eyes	1.75	.71	1.68	.80	.51	124
Blurred vision	1.29	.64	1.38	.77	-.77	118
Stiff arms	1.12	.40	1.11	.36	.15	138
Stiff legs	1.16	.43	1.19	.50	-.43	120
Neck pressure	1.46	.72	1.40	.64	.54	140
Skin rash	1.08	.32	1.18	.55	-1.15	92
Stomach pains	1.19	.51	1.18	.58	.20	122
Swollen joints	1.04	.19	1.06	.25	-.74	112
Hand cramps	1.25	.46	1.16	.48	1.19	130
Sore wrists	1.15	.35	1.04	.22	2.05	137*
Changed colour vision	1.05	.22	1.08	.33	-.66	101
Fainting	1.02	.15	1.02	.13	.35	143
Feeling loss in fingers	1.08	.32	1.03	.18	1.26	132
Headaches	1.92	.67	1.91	.71	.09	128

* P<.05

Table 12.18. **Comparison of the mean scores for the health symptoms (t-test two tailed) between the two stages for the clerks/typists**

	Pre-implementation (N=257)		Post-implementation (N=231)			
	Mean	SD	Mean	SD	T	df
Eyestrain	2.47	1.21	2.37	1.06	1.00	484
Stiff neck	2.26	1.05	2.36	1.13	-.95	471
Burning eyes	1.68	1.00	1.75	.99	-.71	481
Sore shoulders	1.86	1.00	1.98	1.04	-1.33	476
Back pain	2.03	1.08	2.21	1.06	-1.86	482
Irritated eyes	2.02	1.04	2.06	1.00	-.49	483
Blurred vision	1.64	.96	1.51	.79	1.61	482
Stiff arms	1.37	.69	1.42	.75	-.90	469
Stiff legs	1.50	.82	1.48	.81	.23	481
Neck pressure	1.83	1.02	1.89	1.04	-.63	478
Skin rash	1.23	.57	1.21	.60	.26	474
Stomach pains	1.19	.42	1.23	.49	-1.03	456
Swollen joints	1.20	.60	1.25	.64	-.93	471
Hand cramps	1.50	.75	1.50	.74	00	481
Sore wrists	1.29	.61	1.33	.64	-.73	473
Changed colour vision	1.08	.30	1.05	.26	1.17	484
Fainting	1.05	.26	1.03	.16	1.07	430
Feeling loss in fingers	1.09	.33	1.13	.38	-1.23	458
Headaches	2.46	1.04	2.48	1.05	-.19	474

12.6 THE CONTROL GROUPS

12.6.1 Opportunity arose after the pre-implementation questionnaires had been completed to use respondents as a control group at the post-implementation stage. This arose because at OCAO a small section of eight people were allowed to opt out of the trial of the office support system when the number of VDTs being introduced was reduced but were willing to complete the post-implementation questionnaires. In addition at RD, due to the allocation of VDTs not being one per person, 22 respondents indicated on the post-implementation questionnaires that they had not used the VDT, preferring to continue carrying out their tasks as before.

12.6.2 An analysis was carried out comparing the combined group of non-users to the user respondents at OCAO and RD on the post-implementation data. A Mann-Whitney U test examined the two groups for differences as to age, sex and job level and found no significant differences ($P<.05$). A similar test was applied to the health symptom inventory, the JCI, and the attitude variables. The findings are set out in Tables 12.19 and 12.20, which show no significant differences were found on any of these measures. These findings taken in conjunction with the comparisons made between the data from the two stages of the survey (described in Section 12.2) indicates that in this population the impact of the VDTs after approximately 12 months use has not been significant in terms of the users perceptions of their job characteristics, job satisfaction, and well-being.

12.6.3 The survey at the British Library (BL) had been carried out to add some limited confidence to the study. The

respondents were VDT users who were measured at both stages of the survey with the same questionnaires as the main sites in the survey. It was anticipated that with no other major changes occurring for these BL respondents there would be no significant changes found between the measures taken over the 12 month period. If this was found to be the case the stability of the measures over a medium time span would be given some strength so that any results from the main survey could not be attributed to measurement weakness due to administration over such a period. In the extremely complex environment of an organisation the certainty of changes not occurring that will affect the respondents must be placed in some doubt, but there were certainly no changes at BL on the scale comparable to the introduction of a computer system and the users there were continuing to do exactly the same jobs as previously. The general finding that no significant changes occurred on the main measures (JCI, job satisfaction, participation, stress and health) provided confirmation of stability of using them over this time span. Wall and Clegg (1981) took the view, in a longitudinal study of work group redesign, that the JDS measure of job characteristics and general job satisfaction as well as the GHQ12 measure were responsive to changes over a 7 and 13 month period. They do add, however, that perceptions of job characteristics respond "relatively rapidly" to changes to jobs, but the effects on job satisfaction and mental health "are much slower to occur", probably more than 12 months after the change.

Table 12.19. **Comparison of the users and non-users at OCAO and RD on the health symptoms - Mann-Whitney U test.**

	Non-users (N=22) Mean rank	Users (N=86) Mean rank	Z	P
Eyestrain	51.2	55.4	-.60	.55
Stiff neck	55.9	54.2	-.25	.80
Burning eyes	51.3	55.3	-.61	.54
Sore shoulders	55.2	54.3	-.15	.88
Back pain	49.3	55.8	-.96	.34
Irritated eyes	53.8	54.7	-.13	.90
Blurred vision	49.2	55.9	-1.11	.27
Stiff arms	61.1	52.8	-1.66	.10
Stiff legs	51.8	55.2	-.69	.49
Neck pressure	61.3	52.8	-1.36	.17
Skin rash	55.6	54.2	-.35	.73
Stomach pains	54.2	54.6	-.09	.93
Swollen joints	53.1	54.9	-.46	.64
Hand cramps	59.2	53.3	-1.13	.26
Sore wrists	51.6	55.2	-.85	.39
Changed colour vision	52.6	55.0	-.82	.41
Fainting	51.6	55.2	-1.72	.09
Feeling loss in fingers	56.0	54.1	-.53	.59
Headaches	53.0	54.9	-.28	.78

Table 12.20. **Comparison of the users and non-users at OCAO and RD on the job characteristic, stress and attitude variables - Mann-Whitney U test.**

	Non-users (N=22) Mean rank	Users (N=86) Mean rank	Z	P
Variety	55.5	54.9	-.16	.89
Autonomy	53.3	54.8	-.20	.84
Feedback	55.6	54.2	-.18	.86
Task significance	50.3	55.6	-.72	.47
Dealing with others	58.6	53.4	-.70	.48
Friendship	48.6	56.0	-.99	.32
Stress	58.8	53.4	-.72	.47
Participation	53.2	54.8	-.22	.83
Job satisfaction	56.1	54.1	-.28	.78

13 FACTOR ANALYSIS

Chapter Summary

The survey data for the four groups of questions about the office environment, the health symptoms, problems with the VDT, and views about the system were factor analysed. The analysis data is explained and the factors arrived at described.

13.1 SEEKING THE UNDERLYING DIMENSIONS

13.1.1 The analysis presented in the previous chapters used a considerable number of variables which in many instances were not reduced or aggregated in any way from the single items in the questionnaire. In preparation for the path model analysis, it was necessary to reduce the number of items that would be entered into the path model. In order to explore the possibility of there being a number of underlying dimensions in the data obtained in Sections 1, 2 and 5 of the questionnaire (Environmental Conditions, Personal Well-Being, Views of the VDT and Computer System), a factor analysis was carried out. The exploration of the pre-implementation data was carried out with the SPSSX computer package (Principal Components Analysis) using the Oblimin oblique rotation option. This rotation method is more general than an orthogonal rotation in that it does not impose the restriction that factors should be uncorrelated (Kim and Mueller 1978). Kaiser's criterion is applied by the SPSSX programme to assist in determining the number of factors underlying the data. The factors retained should have eigenvalues greater than 1, and even though regarded as being based on heuristic and practical

grounds was preferred by Kaiser after examining more complex methods (Child 1970; Kim and Muellor 1978). In addition, an examination of the structure matrix to select the variables with highest loadings on the factor was carried out. In order that a parsimonous solution was arrived at the base cut-off level was correlation coefficients of no less than 0.60 were selected (Kim and Mueller 1978). Appropriate labels were then assigned to the factor depending on the variables loading onto it. This rule-of thumb was applied in order to select the variables which should be selected to compute the factor for the input to the regression analysis.

13.2 OFFICE ENVIRONMENT

13.2.1 Four factors emerged from the sixteen items of this section of the questionnaire (Section 1, Questions 1 and 2), which accounted for 59.4% of the common factor variance. Table 13.1 shows the eignevalues obtained, which exceeded the value of 1, with the amount of variance that the factors account for in each individual variable. The first group of variables, ENVTI, was related to the discomfort experienced in the office due to cold and draughts. The structure matrix (Table 13.2-page 337) shows the variables with correlations to factors above 0.60. These were selected to compute the factors for the regression analysis.

Table 13.1. **Factor analysis of the Office Environment statements**

Factor	Eigenvalue	Percent of variance
1	4.19	26.2
2	2.39	15.0
3	1.59	9.9
4	1.33	8.3

	COMMUNALITY
WINTER	
it is too warm	.43
it is comfortable	.54
it is too cold	.52
the temperature varies through the day	.68
the temperature remains constant throughout the day	.68
little air movement	.74
there are uncomfortable draughts	.58
the ventilation is satisfactory	.54
SUMMER	
it is too warm	.53
is comfortable	.65
it is too cold	.48
the temperature varies through the day	.57
the temperature remains constant throughout the day	.63
there is little air movement	.80
there are uncomfortable draughts	.59
the ventilation is satisfactory	.53

13.2.2 The correlation matrix for the factors shows that the relationship between the factors is for most of them very small and even the highest correlation between ENVT1 and ENVT4 is not large, 0.34, (see table 13.3) indicating that the factors are reasonably distinct.

Table 13.3. The correlation coefficients between the Office Environment factors

	ENVTI	ENVT2	ENVT3	ENVT4
ENVTI	1.00			
ENVT2	-.08	1.00		
ENVT3	-.03	-.14	1.00	
ENVT4	.34	-.19	-.03	1.00

13.3 HEALTH SYMPTOMS

13.3.1 A similar analysis, applied to the nineteen items of the Health Symptom Inventory (Section 2, Question 1), found 53.9% of the variance accounted for by four factors (Table 13.4). The initial group (ILLNESS1) represents musculo-skeletal problems with six of the symptoms having a correlation with the factor in excess of .65. A second group (ILLNESS2) combines visual symptoms (eyestrain, burning eyes, irritated eyes, blurred vision), whilst two items (hand cramps and stiff sore wrists) in the third factor (ILLNESS3) indicate that the office staff find these problems to be separate from the other aches and pains associated with their joints and limbs (Table 13.5).

13.3.2 The fourth group (ILLNESS4) present only one variable, stomach pains, which correlates relatively highly

(.66) with the factor and a further two variables (skin rash, loss of feeling in fingers or wrists), which are only marginally lower (.56 and .47). This position suggests that the interpretation of this group as a separate factor could be in doubt but the scree test advocated by Cattell (1965) indicates that there are definitely four variables in the eigenvalues plot on the graph before the slope levels off (Diagram 13.1).

13.3.3 The correlations between the factors shows a higher degree of relationship between these factors than there was between the office environmental factors (Table 13.6), indicating that the factors have not separated out as clearly as one would have intuitively expected. Nevertheless the relationships are not too strong.

SCREE TEST DIAGRAM

Diagram 13.1

Table 13.4 **Factor analysis of the Health Symptom Inventory**

Factor	Eignevalue	Percent of variance
1	5.68	29.9
2	1.97	10.4
3	1.41	7.5
4	1.15	6.1

	COMMUNALITY
Eyestrain	.65
Painful/Stiff neck or shoulders	.80
Burning eyes	.73
Sore shoulders	.74
Back pain	.50
Irritated eyes	.79
Blurred vision	.60
Painful/Stiff arms	.53
Painful/Stiff legs	.54
Neck pressure	.61
Skin rash	.25
Stomach pains	.45
Swollen muscles or joints	.31
Hand cramps	.69
Stiff sore wrists	.25
Change in colour perception	.17
Fainting	.18
Loss of feeling in fingers or wrist	.37
Headaches	.42

Table 13.5 Summary of Factor Analysis Structure Matrix of the Health Symptom Inventory

	ILLNESS 1 Musculo-Skeletal Discomfort	ILLNESS 2 Visual Complaints	ILLNESS 3 Hand And Wrist Aches	ILLNESS 4 Pscyho-somatic Ailments
Eyestrain	.44	.78	.20	.27
Painful/Stiff neck or shoulders	.88	.31	.24	.01
Burning eyes	.22	.85	.19	.07
Sore shoulders	.83	.29	.29	-.04
Back pain	.71	.27	.22	.18
Irritated eyes	.27	.89	.26	.19
Blurred vision	.25	.77	.26	.22
Painful/Stiff arms	.68	.27	.33	.37
Painful/Stiff legs	.66	.09	.26	.42
Neck pressure	.77	.32	.29	.08
Skin rash	.20	.27	-.01	.47
Stomach pains	.16	.29	.11	.66
Swollen muscles or joints	.43	.12	.13	.43
Hand cramps	.26	.23	.86	.21
Stiff sore wrists	.34	.26	.82	.11
Change in colour perception	.19	.13	.39	.37
Fainting	.22	.19	.37	-.07
Loss of feeling in fingers or wrists	.12	.12	.32	.56
Headaches	.56	.37	.40	.33

Table 13.6. The correlation coefficients between Health Symptom factors

	ILLNESS 1	ILLNESS 2	ILLNESS 3	ILLNESS 4
ILLNESS 1	1.00			
ILLNESS 2	.32	1.00		
ILLNESS 3	.31	.24	1.00	
ILLNESS 4	.21	.17	.15	1.00

13.4 PROBLEMS WITH THE VDT

13.4.1 Section 5 of the questionnaires, issued at the post-implementation stage, examined the impact of the VDTs and the computer system on the respondents after they had been using the new technology for several months. Question 5 of that section elicited the problems that had arisen regarding the characteristics of the VDT and keyboard. Principal Component Analysis was used, as before, to analyse the thirteen items. The four factors which emerged accounted for 69.0% of the variance (Table 13.7). Characterstics of the screen were the first group of variables (VDTERM1); brightness, contrast, and glare being the variables with the highest correlations with the factor (Table 13.8), whilst the lack of clarity of the characters, flickering, and both the angle and distance of the screen featuring with correlation coefficients just below .60.

13.4.2 Reliability and satisfaction with the servicing of the technology, as well as the legibility of the documents that the users work with, formed the second factor VDTERM2). Concern with the attributes of the workstation keyboard was the main emphasis of the third group (VDTERM3), whilst the system response time was the main variable in the fourth factor (VDTERM4). The factor correlation matrix (Table 13.9)

shows that, with the exception of the correlation between VDTERM1 and VDTERM3, the relationships between these factors is small. Respondents appear to be indicating that if there are minor levels of dissatisfaction with the screen characteristics there will be more serious problems with the angle and distance of the keyboard; there is a negative correlation of 0.46. The structure matrix (Table 13.8) shows very similar strength of correlation coefficients between the problems with the angle and distance of the screen and the two factors VDTERM1 and VDTERM3, although the sign is negative for the latter. On balance therefore, it would appear reasonable to put these two screen features into the screen characteristics factor (VDTERM1) so that it is a combination of the problems related to the screen allowing the keyboard items to stand separately in VDTERM3.

Table 13.7. **Factor analysis of the statements concerning the VDT problems**

Factor	Eigenvalues	Percent of Variance
1	5.05	38.8
2	1.69	13.0
3	1.22	9.4
4	1.01	7.8

	COMMUNALITY
flickering of the screen	.43
brightness of the screen	.77
contrast of the screen	.60
distance of the screen	.71
angle of the screen	.50
the characters on the screen are not clearly recognisable	.46
glare on the screen	.67
the response time of the system	.70
after keying is not adequate the servicing is not adequate	.81
distance to the keyboard	.87
angle of the keyboard	.88
breakdowns causing interruptions	.78

Table 13.8 Summary of the Factor Analysis Structure Matrix of the Statements Concerning the VDT Problems

	VDTERM1 Screen Characteristics	VDTERM2 Reliability of System	VDTERM3 Keyboard comfort	VDTERM4 System Response Time
flickering of the screen	.57	.22	-.54	.23
brightness of the screen	.87	.25	-.31	.04
contrast of the screen	.87	.14	-.39	.23
distance to the screen	.58	.05	-.52	.54
angle of the screen	.60	.09	-.65	.56
the paper documents are not clearly legible	.27	.68	-.09	-.01
the characaters on the screen are not clearly recognisable	.56	.35	-.41	-.13
glare on the screen	.81	.22	-.45	.20
the response time of the system after keying is not adequate	.14	.26	-.14	.81
the servicing is not adequate	.23	.78	-.35	.53
distance to the keyboard	.40	.21	-.93	.20
angle of the keyboard	.43	.17	-.93	.16
breakdowns causing interruptions	.16	.87	-.21	.17

Table 13.9. The correlation coefficients between the factors of the VDT problems

	VDTERM1	VDTERM2	VDTERM3	VDTERM4
VDTERM1	1.00			
VDTERM2	.22	1.00		
VDTERM3	-.46	-.18	1.00	
VDTERM4	.16	.11	-.24	1.00

13.5 VIEWS ABOUT THE SYSTEM

13.5.1 General statements about the system performance were rated in Question 6 of Section 5 of the questionnaire. The factor analysis of these items produced three groups which accounted for 57.8% of the variance (Table 13.10). The nature of the system's commands appears to be the main concept of the first group of variables (SYSTEM1). This combines the items that refer overtly to the commands ("The commands are all straight forward to use" and "Some of the commands are rather obscure") with the statements that indicate that the system is helpful ("The system does not provide me with correct help" and "The system is a real assistance to my work") (Table 13.11). The second factor, SYSTEM2, represents aspects related to learning to use the system, whilst the third factor has the first two items ("The systems messages are easy to understand" and "The replies given by the system are very business like") as the main variables. Despite these main variables of SYSTEM3 appearing to be intuitively related to the first factor the correlation matrix, however, indicates that there is virtually no correlation between the data sets for SYSTEM1 and SYSTEM3 (Table 13.12). This result could be due to an artifact

of the data or that the mathematical structure of the data set is inconsistent with an underlying set of casual factors.

Table 13.10. Factor analysis of the statements about the computer system

Factor	Eigenvalue	Percent of Variance
1	2.99	29.9
2	1.46	14.6
3	1.33	13.3

	COMMUNALITIES
The system messages are easy to understand	.72
The replies given by the system are very "businesslike"	.76
Using the system requires a lot of concentration	.27
The commands are all straightforward to use	.60
I had considerable difficulty learning to use the system	.73
The system does not provide me with the correct help	.63
I had no difficulty learning to use the system	.73
Some of the commands are rather obscure	.49
The system is very tiring to use	.45
The system is of real assistance to my work	.41

Table 13.11 Summary of the factor analysis structure matrix of the statements about the computer system

	SYSTEM1 Commands	SYSTEM2 Learning	SYSTEM3 Function-ality
The systems messages are easy to understand	.38	-.03	.76
The replies given by the system are very "businesslike"	.25	.01	.81
Using the system requires a lot of concentration	.08	.51	.06
The commands are all straight-forward to use	.58	-.53	.34
I had considerable difficulty learning to use the system	.15	.85	-.09
The system does not provide me with the correct help	.73	.43	-.16
I had no difficulty learning to use the system	-.13	-.85	.08
Some of the commands are rather obscure	.63	.41	-.02
The system is very tiring to use	.60	-.13	.14
The system is a real assistance to my work	-.63	-.07	.12

Table 13.12. The correlation coefficients between the factors of the computer system

	SYSTEM1	SYSTEM2	SYSTEM3
SYSTEM1	1.00		
SYSTEM2	.19	1.00	
SYSTEM3	-.07	-.08	1.00

Chapter Summary

The path analysis technique is applied to the data and the office worker's model explored using the survey data. Both the pre- and post-implementation data is used in the path analysis. Also gender and job level differences are examined to see how the paths between the main variables were influenced by these moderating variables. Finally, the adequacy of the model was considered.

14.1 THE PROCEDURE

14.1.1 The case studies and their summary have drawn a number of conclusions from the correlational data which has suggested the existence of underlying processes. However, there cannot be any causal orderings suggested by correlational data (Warwick and Lininger 1975, Cook and Campbell 1979, Nachmias and Nachmias 1981) but the application of a structured model can go some way towards addressing this issue (Billings and Wroten 1978, Wineman 1986). The use of a model can assist in the understanding of how the change in any one variable in the proposed model affects the values of the other variables which were measured in the system. It does not, however, allow the researcher to "prove" causation but it provides the means for the model, which hypothesises the casual direction, to be tested. The proposed model under scrutiny was outlined in Section 4.2.

14.1.2 In order to explore the interactions postulated in the model a series of path analyses were completed. Hierarchical regression analysis was performed to establish the path coefficients, which are the standardised beta weights in the regression model (Land, 1973). The "theory trimming" approach was employed (Billings and Wroten 1978, Motowildo et al 1986, Wineman 1986), where all the variables prior to a given variable are entered as predictors, and paths are deleted which do not have significant path coefficients. The path coefficients thus produced form a restricted model and these are in turn regressed only on the antecedent variables which remain with direct paths to them. "Trimming" was executed at three levels of the model; firstly all the preceding variables were regressed on the four ILLNESS criterion variables (musculosketal, visual, hand/wrist, pyscho-somatic), secondly all the preceding variables were regressed on the three affective variables (stress, job satisfaction, participation), and thirdly the four individual characteristics were regressed on the job characteristic dimensions, the office environment and computer system factors (VDTERM, SYSTEM).

14.2 THE PRE-IMPLEMENTATION MODEL

14.2.1 The primary analyses consisted of the step-wise multiple regressions of the pre-implementation data, completed in the three stages described above; Table 14.1 shows the standardised beta weights which reached statistical significance ($P<.05$). The interaction paths, which make a significant contribution to the explanation of the criterion variables, are shown in Diagrams 14.1-3 in Appendix 5. For the full sample of the four DHSS sites ($N = 342$), eight variables

focused on the ILLNESS measures having attained significance for retention in the model. The total of the variance explained for three of the factors was over 20% for each (ILLNESS1, 2, 4), but only 10% of ILLNESS 3 was explained. In Diagram 14.1, it can be seen that stress had a direct path to all four ILLNESS factors, with the path coefficients lying between .18 and .33. On the other hand, there was no path from the job satisfaction or participation measures. A direct inverse path between the lighting levels and the four criterion variables was established, poorer perceptions of the lighting levels being linked to greater frequencies of ill health. The more cold and draughts are felt the more frequently are the health symptoms reported, other than the visual symptoms. Two job characteristics, autonomy and dealing with others, are related to musculoskeletal discomfort and may be an indication that the less the person has dealing with others, the more static they remain at the desk and do not get the benefit of physical activity which reduces the static muscular stresses on the body.

14.2.2 Diagram 14.2 shows the paths between the antecedent variables and the affective variables. The variance accounted for is quite high, with 48% for participation, 44% stress, and 37% job satisfaction. The model proposes that job satisfaction has the highest path coefficient, with stress showing clearly that the lower the level of satisfaction the greater the degree of stress. Similarly, Wall et al (1978) report a stronger association between the GHQ12 and job satisfaction than with the core dimensions or the critical psychological states (experienced meaning, responsibility and knowledge of

results) of the Job Characteristics Model. There is also, in addition, an inverse direct path between autonomy and stress.

14.2.3 The amount of variety in the job has the highest path coefficient with job satisfaction, followed closely by feeling that the office has a comfortable temperature. Besides autonomy having a clear influence upon the participation measure, there is the effect of interpersonal relationships reflected in the two social relationship job characteristics; the more the respondents have contact with others the more they appear to feel involved, though the opposite and somewhat conflicting trend is present for the friendship dimension. Those with a lower score on the friendship dimension feel that they have more participation. This may indicate that the dimension of dealing with others is more closely related to a work oriented activity thereby imparting a feeling of greater involvement in the decisions being made, whereas those seeking and developing more friendships feel relatively more removed from the decision making. Job satisfaction is also influenced by a social relationship dimension, dealing with others. Variety is the only other job characteristic which has a direct path to job satisfaction, and it has the highest path coefficient of the variables which are linked to job satisfaction. The respondent's job satisfaction level also has a direct path from experiencing comfortable temperatures in the office, having a path coefficient almost as high as the variety dimension.

14.2.4 The direct paths shown in Diagram 14.3 indicate that the younger age groups also appear to be less tolerant of the office environmental aspects. A feeling of dissatisfaction

with their chair, desk, lighting levels, office noise, and the ambient temperature, is greater among the younger employees. The job satisfaction mean score for the under 19 year olds is 46.8, SD 11.7, whilst for the 50-59 age group is 67.6, SD 9.1. It has been suggested that there could well be a relationship between the level of job satisfaction and the acceptance of the environmental factors; the environment being seen as more acceptable if the level of job satisfaction is high, whilst the same environment being seen as unsatisfactory if the level of job satisfaction is low (Sundstrom, 1986).

14.2.5 Age is also directly linked to the job satisfaction score, being lower for the younger age groups and increases for the older age groups. This is similar to the findings in other studies where the older employees score higher on job satisfaction measures (Katz, 1978; Lee and Wilbur, 1985; Mottaz, 1987). The opposite trend is the case for the path with age and the psycho-somatic ailments; here the younger employee is reporting greater levels of these symptoms, which is consistent with the indirect pathways linking age through job satisfaction and stress to the psycho-somatic ailment. Age and job level are associated with job variety. This is not an unexpected result for the younger employees because the majority of them are in the lower level grades, engaged in very routine filing and registration of papers. This group of respondents also has less dealings with others in their jobs. This confirms the findings of studies into the job activities of office workers which have found that managers spend in the order of 60% of their time in interpersonal communication, whilst clerks and secretaries between 10% and 15% (Doswell, 1983).

14.2.6 The gender of the office worker is related to a number of outcomes at the three levels of the model's analysis. Both musculo-skeletal discomfort and psycho-somatic ailments are reported more frequently by women than by men. The women however have higher levels of job satisfaction, with the men finding the noise levels in the office more distracting in their work. Research examining the gender effects on the levels of job satisfaction have generally had conflicting results, with a recent study (Neil and Snizek, 1988) finding that there were no differences due to gender when the differences in organisational power and promotion opportunity are controlled.

Table 14.1 Full Sample Regression at the Pre-Implementation Stage

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS 1					
(Musculo - skeletal)	Stress	.11	.000	.28	
	Sex	.15	.000	.16	
	Light	.18	.000	-.13	df=7
	Dealing with others	.21	.000	-.21	F=12.97
	ENVT3 (Stuffy Atmosphere)	.23	.000	.15	P<.0000
	Autonomy	.25			
	ENVT1 (Cold/Draughts)	.27	.000	.13	
ILLNESS 2					
(Visual)	Light	.15	.000	-.32	df=2
	Stress	.21	.000	.27	F=35.16
					P<.000
ILLNESS 3					
(Hand/wrist)	Stress	.05	.000	.18	df=3
	ENVT1 (Cold/Draughts)	.08	.000	.15	F=9.66
	Light	.10	.000	-.14	P<.0000
ILLNESS4					
(Psycho-somatic)	Stress	.17	.000	.33	
	Light	.21	.000	-.16	df 6
	Sex	.24	.000	.16	F=16.49
	ENVT1 (Cold/Draughts)	.26	.000	.19	P<.0000
	Age	.27	.000	-.12	
	ENVT4 (Variable Temperature)	.28	.000	-.12	

Table 14.1 (Cont'd)

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
STRESS	Job satifaction	.39	.000	-.58	df=3
	Autonomy	.43	.000	-.20	F=65.35
	Chair	.44	.000	-.11	P<.0000
PARTICIPATION	Job level	.23	.000	-.36	df=5
	Autonomy	.38	.000	.33	F=44.69
	Dealing with others	.42	.000	.24	P<.0000
	ENVT2 (Comfortable Temperature)	.46	.000	.19	
	Noise	.47	.000	-.11	
	Friendship	-.48		-.15	
JOB SATISFACTION	Variety	.22	.000	.34	df=5
	ENVT2 (Comfortable Temperature)	.32	.000	.29	F=30.14
	Age	.35	.000	.17	P<.0000
	Dealing with others	.36	.000	.15	
	Sex	.37	.000	.12	
ENVT2 (Comfortable Temperature)	Age	.09	.000	.33	df=2
	Education	.13	.000	.19	F=19.10
					P<.0000
ENVT3 (Stuffy Atmosphere)	Age	.08	.000	-.29	df=1
					F=23.46
					P<.0000
ENVT4 (Variable Temperature)	Education	.05	.000	-.22	df=1
					F=12.51
					P<.0005

Table 14.1 (Cont'd)

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
Light	Job level	.05	.000	-.19	df=2
	Age	.07	.000	.14	F=12.43
					P<.0005
Noise	Age	.02	.000	.13	df=2
	Sex	.03	.000	-.12	F=5.91
					P<.003
Desk	Age	.02	.006	.16	df=2
	Education	.03	.003	.11	F = 5.92
					P<.003
Chair	Age	.03	.001	.19	df=1
					F=12.07
					P<.0000
Variety	Job level	.14	.000	-.35	df=2
	Age	.16	.000	.13	F = 31.89
					P<.0000
Dealing with others	Job	.11	.000	-.33	df=1
					F=41.26
					P<.0000
Friendship	Age	.02	.01	-.17	df=2
	Job level	.03	.002	-.13	F=6.16
					P<.002

14.3 THE POST-IMPLEMENTATION MODEL

14.3.1 Using the same method of analysis, the post-implementation data was examined. The amount of the variance explained by the independent variables of the ILLNESS factors at the post-implementation stage, was slightly higher for musculo-skeletal (33%), visual complaints (31%), and the hand and wrist aches (17%), but lower for the psycho-somatic ailments (24%) (Table 14.2).

14.3.2 There are however differences in the paths to the antecedent variables between the two sets of data and a comparison is shown in Table 14.4. With respect to the ILLNESS criterion variables, gender was a common antecedent variable with direct paths found for ILLNESS1, and ILLNESS4; stress was found to have a direct path to ILLNESS2, ILLNESS3, and ILLNESS4 and the "lighting being satisfactory" (Light) to ILLNESS2. Although no specific hypotheses were proposed, it is interesting to note the common antecedent variables between the models analysed from the two data sets. In particular, irrespective of the use of VDTs, the greater the levels of stress the more frequent are the health symptoms reported for all the health factors other than musculo-skeletal discomfort. It also appears to be a consistent feature that the female workers report a higher incidence of both musculo-skeletal discomfort and psycho-somatic ailments.

14.3.3 The amount of variance explained by the antecedent variables, which were regressed on the affective variables, was similar for both stages and (stress 44% and 46%, participation 48% and 42%, job satisfaction 37% and 36% respectively). The antecedent variables for the affective

measures have some variables with direct paths for both sets of data (job satisfaction for stress; job level, autonomy, and dealing with others for participation; variety and age for job satisfaction)(See Table 14.4). For both the job satisfaction and participation measures the direct paths from ENVT2 (comfortable temperature) dropped out of the model after the implementation of the computer and two VDT related factors, VDTERM2 (system reliability) and SYSTEM3 (functionality), are among the new paths from the antecedent variables. Although this result should be viewed cautiously, because the amount of predicted variance is under 10%, it does support other research findings that link users attitudes to system performance criteria (Eason, 1982; Bikson and Gutek, 1983; Spinas, 1987).

14.3.4 The results from the post-implementation path analysis relating to the influence of the respondents personal characteristics are shown in Table 14.2 and in diagrams 14.6 to 14.8. Job level is consistently linked to many of the variables at the third level of analysis, eg variety, dealing with others, age with job variety and three of the environment factors (comfortable temperature, the lighting levels, noise distractions), whilst education has direct paths to how comfortable the ambient temperature is perceived and the amount of satisfaction with the desk. Some of the VDT characteristics are linked, in the post-implementation data set, to age and education; VDTERM2, SYSTEM1, SYSTEM2 and the number of hours spent on the VDT in a day. The personal characteristics accounted for a small amount of variance, usually under 10%, though there are some exceptions eg ENVT2, variety in the job, and dealing with others at the pre-

implementation stage, and ENVT2, the lighting level, variety in the job, VDTERM2, and SYSTEM2 at the post-implementation stage, lying between 11% and 20%.

Table 14.2 Full Sample Regression at the Post-Implementation Stage

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS1 (Musculo-skeletal)	Variety	.16	.000	-.26	df=8 F=14.64 P< .0000
	VDTERM2 (Reliability of system	.21	.000	.16	
	VDTERM1 (Screen characteristics)	.24	.000	.18	
	Sex	.27	.000	.16	
	Job satisfaction	.29	.000	-.13	
	Autonomy	.30	.000	.12	
	Chair	.31	.000	-.20	
	Desk	.33	.000	.17	
ILLNESS2 (Visual)	Light	.16	.000	-.25	df=6 F=18.07 P< .0000
	Stress	.21	.000	.21	
	Variety	.24	.000	-.22	
	Task significance	.27	.000	.18	
	VDTERM1 (screen characteristics)	.29	.000	.23	
	VDTERM3 (VDT comfort)	.31	.000	-.16	
ILLNESS3 (Hand/wrists)	VDTERM1 (Screen Characteristics	.09	.000	.21	df=4 F=12.97 P< .0000
	Chair	.13	.000	-.19	
	Sex	.16	.000	.14	
	Stress	.17	.000	.14	

Table 14.2 (Cont'd)

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS4 (Psycho-somatic)	Stress	.11	.000	.23	df=5
	VDTERM2 (Reliability of system)	.17	.000	.18	F=15.64 P< .0000
	Sex	.20	.000	.15	
	ENVT1 (Cold/draughts)	.22	.000	.15	
				.17	
	Age	.24	.000	-.13	
STRESS	Job satisfaction	.39	.000	-.62	df=3
	Noise	.44	.000	.21	F=70.80
	Friendship	.46	.000	-.16	P< .0000
PARTICIPATION	Autonomy	.21	.000	.35	df=6
	VDTERM2				F=29.22
					P< .0000
	(Reliability of system)	.30	.000	-.13	
	Light	.34	.000	.17	
	Dealing with others	.37	.000	.18	
	Job level	.40	.000	-.16	
	Age	.42	.000	.14	
JOB SATISFACTION	Variety	.22	.000	.23	df=6
	Age	.30	.000	.28	F=23.24
	Feedback	.32	.000	.13	P< .0000
	VDTERM2 (reliability of system)	.34	.000	-.16	
	SYSTEM3	.35	.000	.12	
	Task significance	.36	.000	.11	
ENVT2 (Comfortable Temperature)	Age	.06	.000	.22	df=3
	Education	.11	.000	.16	F=13.40
	Job level	.13	.000	-.14	P< .0000

Table 14.2 (Cont'd)

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
ENVT3 (Stuffy atmosphere)	Job level	.07	.000	.23	df=2
	Age	.10	.000	-.18	F=15.70
					P< .0000
ENVT4 (Variable Temperature)	Sex	.02	.024	.14	df=1
					F=5.16
					P< .024
Light	Education	.05	.000	.19	df=3
	Age	.10	.000	.20	F=12.49
	Sex	.12	.000	-.14	P< .0000
Noise	Age	.02	.015	.14	df=2
	Education	.03	.006	.12	F=5.19
					P< .006
Desk	Education	.04	.001	.20	df=1
					F=12.11
					P< .0006
Chair	Job level	.03	.006	-.16	df=1
					F=7.62
					P< .006
Variety	Job level	.10	.000	-.19	df=3
	Education	.14	.000	.23	F=21.40
	Age	.18	.000	.20	P< .0000
Autonomy	Job level	.02	.011	-.15	df=1
					F=6.51
					P< .011

Table 14.2 (Cont'd)

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
Feedback	Education	.02	.028	.13	df=1 F=4.86 P< .028
Dealing with others	Education Job level	.04 .06	.000 .000	.15 -.14	df=2 F=8.91 P< .0002
Friendship	Education Age	.03 .05	.002 .000	.18 -.15	df=2 F=8.37 P< .0003
VDTERM1 (Screen characteristics)	Job level	.03	.008	.16	df=1 F=7.23 P< .008
VDTERM2 (system reliability)	Job level Age Education	.12 .17 .20	.000 .000 .000	.22 -.24 -.20	df=3 F=22.61 P< .0000
VDTERM3 (VDT Comfort)	Job level	.02	.018	.14	df=1 F=5.69 P< .018
VDTERM4 (SRT)	Education	.04	.001	.20	df=1 F=10.77 P< .001
Time spent in day on VDT	Age Job level	.02 .05	.011 .000	.19 .18	df=1 F=8.19 P< .0003

Table 14.2 (Cont'd)

Criterion Variable	Independent Variable	R^2	Significance of Change	Beta	Test of Model
SYSTEM 1 (Commands)	Age	.06	.000	-.25	df=1 F=18.37 P< .0000
SYSTEM 2 (Learning)	Age Job level	.08 .11	.000 .000	-.25 .17	df=2 F=16.21 P< .0000

Table 14.4 Comparison of the significant antecedant path coefficients of the pre and post-implementation models

Criterion Variables	Pre-implementation Antecedant Variables	Beta	Post-implementation Antecedant Variables	Beta
ILLNESS1 (Musculo-skeletal	Stress	.28		
	Sex	.16	Sex	.16
	Light	.13	Job	-.13
	Dealing with others	-.21		
	ENVT3	.15		
	Autonomy	.15		
	ENVT1	.13		
ILLNESS2 (Visual)	Light	-.32	Light	-.25
	Stress	.27	Stress	.21
			VDTERM1	.23
			VDTERM3	-.16
			Variety	-.22
			Task significance	.18
ILLNESS3 (Hand/wrist)	Stress	.18	Stress	.14
	Light	-.14	Age	-.13
	ENVT1	.15	ENVT1	.15
			Sex	.14
			Chair	-.19
			VDTERM1	.21
ILLNESS4 (Psycho-somatic)	Stress	.33	Stress	.26
	ENVT1	.19		
	Age	-.12		
	Sex	.16	Sex	.17
	ENVT4	-.12	VDTERM2	.18
STRESS	Job Satisfaction	-.58	Job Satisfaction	-.62
	Autonomy	-.20	Noise	.21
	Chair	-.11	Friendship	-.16
PARTICIPATION	Job level	-.36	Job level	-.16
	Autonomy	.33	Autonomy	.35
	Dealing with others	.24	Dealing with others	.18
	ENVT2	.19	Age	.14
	Noise	-.11	Light	.17
	Friendship	-.15	VDTERM2	-.13
JOB SATISFACTION	Variety	.34	Variety	.23
	Age	.17	Age	.28
	ENVT2	.29	VDTERM2	-.16
	Sex	.12	SYSTEM3	.12
	Dealing with others	.15	Feedback	.13
			Task significance	.11

Gender Influences

14.3.5 Because the gender of the respondent has a direct path to some of the ILLNESS factors for each set of data, regressions were run separately by gender for the ILLNESS and the affective variables on the results from the four sites at the post-implementation stage. Tables 14.5 and 14.6 show the results for the females (n=183) and the males (n=95) respectively (also see diagrams 14.10-14.13). The amount of variance accounted for in the models was similar for four of the seven criterion variables (22%-26% for ILLNESS3 and 4,50% for Stress, and 37/39% for Job satisfaction). The variance accounted for was higher for the males on the musculo-skeletal discomforts and visual complaints as well as the participation score. Thus for males, it was the stuffy atmosphere in the office and the VDT screen characteristics which played a major part in predicting their musculo-skeletal discomfort. On the other hand, whilst it was the breakdowns of the VDT and the poor lighting levels which influenced the females. The lack of variety in the job accounted for a small percentage for both groups. Similarly, the variables predicting the other ILLNESS factors varied for each group, with the exception of VDTERM1 regressing on ILLNESS3 and Stress on ILLNESS4 for both groups. The variables accounting for the greater amount of variance for Stress, Participation, and Job Satisfaction were job satisfaction, autonomy, and variety respectively for both males and females.

Table 14.5 Female Sample (N=183) Regression at the Post-Implementation Stage

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS1	VDTERM2	.16	.000	.28	df=3
(Musculo-skeletal)	(Reliability of system)				F=17.59
	Variety	.23	.000	-.27	P< .0000
	Light	.26	.000	-.16	
ILLNESS2	Light	.14	.000	-.30	df=3
(Visual)	Variety	.20	.000	-.20	F=14.66
	VDTERM2	.23	.000	.17	P< .0000
	(Reliability of system)				
ILLNESS3					
(Hand/wrist)	Chair	.11	.000	-.23	df=5
	VDTERM1	.15	.000	.18	F=8.99
	(Screen characteristics)				P< .0000
	Stress	.19	.000	.15	
	ENVT1				
	(Cold/draughts)	.21	.000	.18	
	Variety	.23	.000	-.16	
ILLNESS4					
(Psycho-somatic)	Stress	.09	.000	.22	df=3
	Chair	.16	.000	-.26	F=14.16
	Age	.22	.000	-.25	P< .0000
STRESS	Job satisfaction	.36	.000	-.68	df=4
	Noise	.42	.000	.22	F=37.17
	Friendship	.47	.000	-.28	P< .0000
	Variety	.50	.000	.17	

Table 14.5 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
PATICIPATIONN	Autonomy	.13	.000	.34	df=5
	VDTERM2 (Reliability of system)	.22	.000	-.22	F=14.47 P< .0000
	Dealing with others	.26	.000	.22	
	Light	.30	.000	.21	
	System 1 (Commands)	.33	.000	-.16	
JOB SATISFACTION	Variety	.20	.000	.24	df=4
	VDTERM2 (Reliability of system)	.30	.000	-.29	F=23.70 P< .0000
	Age	.37	.000	.27	
	Feedback	.39	.000	.15	

Table 14.6 Male Sample (N=95) Regression at the Post-Implementation Stage

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS 1 (Musculo-skeletal)	VDTERM1 (Screen Characteristics)	.23	.000	.37	df=3 F=20.21
	ENVT3 (Stuffy Atmosphere)	.35	.000	.29	P< .0000
	Variety	.40	.000	-.24	
ILLNESS 2 (Visual)	VDTERM1 (Screen characteristics)	.22	.000	.33	df=6 F=12.46
	Stress	.31	.000	.38	
	Task significance	.36	.000	.22	P< .0000
	VDTERM3 (VDT Comfort)	.42	.000	-.22	
	ENVT3 (Stuffy Atmosphere)	.45	.000	.24	
	Hours in day on VDT	.48	.000	.18	
ILLNESS 3 (Hand/wrist)	VDTERM1 (Screen Characteristics)	.14	.000	.28	df=3 F=9.57
	Friendship	.20	.000	-.31	P< .0000
	Age	.24	.000	-.20	
ILLNESS 4 (Psycho-somatic)	Stress	.12	.001	.30	df=3
	VDTERM2 (Reliability of system)	.22	.000	.29	F=10.37
	Maximum hours at any one time on VDT	.26	.000	-.19	P< .0000

Table 14.6 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
STRESS	Job satisfaction	.42	.000	-.53	df=3
	Task significance	.46	.000	-.23	F=20.78
	VDTERM1	.50	.000	.21	P< .0000
PARTICIPATION	Autonomy	.39	.000	.47	df=3
	Job level	.46	.000	-.22	F=29.92
	Variety	.50	.000	.22	P< .0000
JOB SATISFACTION	Variety	.21	.000	.28	df=3
	Dealing with others	.30	.000	.32	F=17.82
	Chair	.37	.000	.27	P< .0000

Job Level Effects

14.3.6 The results, from the path analysis of the data had found that the level of the respondent's job had direct paths to the main groups of variables; office environment, workstation, job characteristics, and VDT/system features. In view of this, and the previous findings of some research indicating that there is a difference in response to the use of the VDTs by different occupational groups (Staehle 1982, Dy 1985, Knave and Bergquist 1985, Leppanen 1985, Bjorn-Anderson et al 1986), the job categories of this study were dichotomised into two groups; the managers and professionals in the high job group and the clerical and typist/ secretaries in the low job group.

14.3.7 Path models were produced separately for the ILLNESS and the affective variables on the post-implementation data for each job group. Tables 14.7 and 14.8 show the results for the high job (n=58) and the low job (n=193) groups respectively (also see diagrams 14.14-14.17). The amount of variance accounted for in the models was similar for four of the seven criterion variables (18%-19% for ILLNESS3 and 27%-29% for ILLNESS4, 47% for Stress, and 33-36% for participation). These same criterion variables had a similar amount of variance for the male/female group's path models. This may be due to the sparsity of the number of females in the high job group, thereby influencing the results in a similar direction. The amount of variance was higher, by approximately 10%, for the high job group for the other variables; ILLNESS1, ILLNESS2, and Job Satisfaction.

Table 14.7 Manager and Professional Sample (N=58) Regression at the Post-Implemented Stage

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS1 (Musculo-skeletaL)	VDTERM1 (Screen characteristics)	.21	.000	.37	df=3 F=9.30
	ENVT3 (Stuffy Atmosphere)	.29	.000	.30	P< .0000
	Dealing with others	.34	.000	-.23	
ILLNESS2 (Visual)	Stress	.14	.003	.32	df=5
	Hours on VDT	.29	.000	.36	F=9.23
	Friendship	.37	.000	.36	P< .0000
	Dealing with others	.42	.000	-.27	
	ENVT3 (Stuffy Atmosphere)	.47	.000	.23	
ILLNESS3 (Hand/wrist)	VDTERM2 (Reliability of system)	.11	.012	.37	df=2 F=6.35
	ENVT2 (Comfortable Temperature)	.19	.003	.29	P< .0000
ILLNESS4 (Psycho-somatic)	Stress	.13	.006	.42	df=2
	Task significance	.27	.002	.29	F=6.99 P< .002
STRESS	Job satisfaction	.39	.000	-.50	df=2
	Noise	.47	.000	.31	F=23.88 P< .0000

Table 14.7 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
PARTICIPATION	Autonomy	.24	.000	.33	df=3
	Dealing with others	.31	.000	.32	F=10.13
	Desk	.36	.000	.24	P< .0000
JOB SATISFACTION	Dealing with others	.29	.000	.34	df=3
	Variety	.42	.000	.33	F=16.05
	SYSTEM 3 (Functionality)	.47	.000	.25	P< .0000

Table 14.8 Clerical and Secretarial/Typist Sample (N=193) Regression at the Post-Implementation Stage

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS1 (Musculo-skeletal)	Job satisfaction	.13	.000	-.25	df=5
	Variety	.18	.000	-.28	F=12.80
	Sex	.21	.000	.16	P< .0000
	VDTERM1 (Screen characteristics)	.24	.000	.17	
	Autonomy	.25	.000	.14	
ILLNESS2 (Visual)	Light	.18	.000	-.35	df=7
	VDTERM1 (Screen characteristics)	.25	.000	.19	F=14.23
	SYSTEM1 (Commands)	.28	.000	.28	P< .0000
	SYSTEM2 (Learning)	.30	.000	-.19	
	Task significance	.32	.000	.20	
	Variety	.34	.000	-.20	
	Stress	.36	.000	.23	
ILLNESS3 (Hand/wrist)	VDTERM1 (Screen characteristics)	.09	.000	.22	df=4
	Stress	.13	.000	.18	F=10.31
	Chair	.16	.000	-.19	P< .0000
	Sex	.18	.000	.14	
ILLNESS4 (Pyscho-somatic)	Stress	.09	.000	.19	df=6
	Light	.15	.000	-.13	F=11.89
	Sex	.19	.000	.22	P< .0000

Table 14.8 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
	ENVT1 (Cold/Draughts)	.24	.000	.21	
	Age	.27	.000	-.17	
	Variety	.29	.000	-.18	
STRESS	Job satisfaction	.37	.000	-.63	df=4
	Noise	.42	.000	.18	F=41.82
	Friendship	.46	.000	-.17	P< .0000
	SYSTEM1 (Commands)	.47	.000	-.13	
PARTICIPATION	Autonomy	.19	.000	.40	df=5
	Feedback	.25	.000	.30	F=18.76
	Light	.29	.000	.17	P< .0000
	Age	.32	.000	.14	
	SYSTEM2 (Learning)	.33	.000	-.13	
JOB SATISFACTION	Variety	.16	.000	.18	df=5
	Age	.26	.000	.29	F=18.61
	Task significance	.28	.000	.15	P< .0000
	VDTERM2 (Reliability of system)	.32	.000	-.21	
	Feedback	.33	.000	.15	

For both groups stress plays a part in the amount of variance accounted for in the visual discomfort and psycho-somatic ailments, whilst job satisfaction, autonomy, and variety feature as significant antecedent variables for the criterion variables of Stress, Participation, and Job Satisfaction respectively.

14.4 THE ADEQUACY OF THE MODEL

14.4.1 One of the more serious problems in the use of the stepwise multiple regression analysis arises when there are a large number of independent variables. This is because of the number of significance tests being executed at the same time on the competing variables. In addition, the ad hoc order produced from a set of variables in one sample is unlikely to be repeated in other samples from the same population. The level of criticism, however, can be reduced if the research is primarily exploratory, and not explanatory and employs a large sample. A cross validation of the analysis can be undertaken by comparing a randomly selected sample, drawn from the original sample, and only the findings that hold true for both samples be accepted with any degree of confidence (Cohen and Cohen, 1975).

14.4.2 A random sample (50%) was selected by the SPSSX programme from the pre-implementation and the post-implementation (the four sites) sets of data. The path analysis model was then calculated on the same basis as the analysis had been performed on the data of the full sample. Tables 14.9 and 14.10 show the results obtained from the

Table 14.9 Pre-Implementation Regression of the Random Sample Data from the Four Sites (N=181)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS1 (Musculo-skeletal)	Job satisfaction	.11	.000	-.29	df=3
	Chair	.15	.000	-.20	F=9.94
	Sex	.18	.000	.18	P< .0000
ILLNESS2 (Visual)	Light	.17	.000	-.34	df=2
	Stress	.24	.000	.29	F=21.47
					P< .0000
ILLNESS3 (Hand/wrist)	Stress	.09	.000	.26	df=2
	Light	.12	.000	-.18	F=9.17
					P< .0002
ILLNESS4 (Pyscho-somatic)	Stress	.16	.000	.35	df=3
	Light	.23	.000	-.26	F=16.04
	Sex	.27	.000	.19	P< .0000
STRESS	Job satisfaction	.38	.000	-.60	df=2
	Autonomy	.41	.000	-.17	F=45.80
					P< .0000
PARTICIPATION	Job level	.22	.000	-.37	
	Autonomy	.32	.000	.24	df=5
	Dealing with others	.37	.000	.25	F=19.80
					P< .0000

Table 14.9 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
	ENVT2 (Comfortable Temperature)	.41	.000	.21	
	Noise	.43	.000	-.14	
JOB SATISFACTION	Variety	.28	.000	.37	df=5 F=21.85 P< .0000
	ENVT2 (Comfortable Temperature)	.38	.000	.30	
	Sex	.40	.000	.19	
	Dealing with others	.43	.000	.22	
	ENVT3 (Stuffy Atmosphere)	.46	.000	-.16	
ENVT2 (Comfortable Temperature)	Age	.16	.000	.41	df=2 F=17.79 P< .0000
	Education	.20	.000	.22	
ENVT3 (Stuffy Atmosphere)	Age	.08	.001	-.29	df=1 F=12.21 P< .0006
ENVT4 (Variable Temperature)	Education	.04	.02	-.20	df=1 F=5.55 P< .02
Light	Age	.06	.001	.26	df=2 F=9.76 P< .0001
	Education	.10	.000	.19	

Table 14.9 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
Noise	Age	.02	.045	.15	df=1 F=4.09 P< .05
Desk	Education	.03	.02	.17	df=1 F=5.41 P< .02
Chair	Age	.02	.04	.15	df=1 F=4.29 P< .04
Variety	Job level Age	.17 .23	.000 .000	-.34 .26	df=2 F=26.49 P< .0000
Dealing with others	Job level	.13	.000	-.35	df=1 F=25.29 P< .0000
Friendship	Age	.03	.018	-.18	df=1 F=5.68 P< .018

Table 14.10 Post-Implementation Regression of the Random Sample Data from the Four Sites (N=154)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS1 (Musculo-skeletal	Variety	.21	.000	-.20	df=4
	ENVT3 (Stuffy Atmosphere)	.29	.000	.21	F=16.09 P< .0000
	VDTERM2 (Reliability of system)	.32	.000	.21	
	Job satisfaction	.34	.000	-.19	
ILLNESS2 (Visual)	VDTERM1 (Screen characteristics)	.18	.000	.43	df=5 F=15.32 P< .0000
	Variety	.29	.000	-.19	
	VDTERM3 (VDT Comfort)	.32	.000	-.21	
	Light	.36	.000	-.19	
	VDTERM2 (Reliability of system)	.38	.000	.19	
ILLNESS3 Hand/wrist	VDTERM1 (Screen characteristics)	.14	.000	.36	df=3 F=12.07 P< .0000
	VDTERM2 (Reliability of system)	.20	.000	.28	
	VDTERM4 (SRT)	.23	.000	-.17	

Table 14.10 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ILLNESS4 (Psycho-somatic)	Variety	.09	.000	-.27	df=5
	Stress	.13	.000	.31	F=8.87
	Task significance	.19	.000	.26	P<.0000
	ENVT1 (Colds/Draughts)	.22	.000	.23	
	Noise	.27	.000	-.23	
STRESS	Job satisfaction	.39	.000	-.60	df=3
	Noise	.43	.000	.20	F=36.11
	Friendship	.46	.000	-.18	P< .0000
PARITICIPATION	Autonomy	.21	.000	.40	df=6
	Job level	.30	.000	-.14	F=14.81
	Light	.33	.000	.17	P< .0000
	SYSTEM2 (Learning)	.37	.000	-.19	
	Feedback	.40	.000	.20	
	VDTERM2 (Reliability of system)	.42	.000	-.16	
JOB SATISFACTION	Variety	.29	.000	.47	df=2
	Age	.33	.000	.22	F=31.20
					P< .0000
ENVT2 (Comfortable Temperature)	Education	.08	.000	.29	df=2
	Age	.12	.000	.19	F=9.61
					P< .0001

Table 14.10 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
ENVT3 (Stuffy Atmosphere)	Job level	.11	.000	.33	df=1 F=17.05 P< .0001
Light	Education	.05	.008	.22	df=1 F=7.32 P< .008
Noise	Job level	.03	.019	-.19	df=1 F=5.61 P< .02
Desk	Education	.05	.009	.21	df=1 F=7.03 P< .009
Variety	Education Age	.09 .19	.000 .000	.31 .30	df=1 F=17.23 P< .0000
Dealing with others	Job level	.03	.028	-.18	df=1 F=4.91 P< .03
Friendship	Education Sex	.03 .06	.024 .008	.22 .18	df=2 F=5.03 P< .008

Table 14.10 (Cont'd)

Criterion Variable	Independant Variable	R^2	Significance of Change	Beta	Test of Model
VDTERM2 (System Reliability)	Job level	.16	.000	.24	df=3
	Education	.19	.000	-.23	F=12.87
	Age	.22	.000	-.19	P< .0000
VDTERM3 (VDT Comfort)	Age	.05	.011	.22	df=1 F=6.70 P< .01
VDTERM4 (SRT)	Education	.05	.006	.23	df=1 F=7.66 P< .006
VDT Hours in the day	Sex	.03	.033	.21	df=2
	Age	.06	.007	.19	F=5.10 P< .007
SYSTEM1 (Commands)	Age	.06	.003	-.25	df=1 F=9.13 P< .003
SYSTEM2 (Learning)	Job level	.16	.000	.33	df=2
	Age	.20	.000	-.20	F=16.41 P< .0000
SYSTEM3 (Functionality)	Job level	.04	.015	.21	df=1 F=6.01 P< .016

pre-implementation data set (N=181) and the post-implementation data set (N=154) respectively. Diagrams 14.18 to 14.23 illustrate the findings in form of the path analysis model.

14.4.3 In the pre-implementation path analysis model (diagrams 14.1 and 14.18) there are still direct paths from sex to ILLNESS1 and ILLNESS4. The paths from Stress and Light, however, remain with direct paths to ILLNESS2-4 in the random sample's path model whilst also having paths to ILLNESS1 in the full sample path model. In addition, the random sample model direct paths from two job characteristics (autonomy, dealing with others) and three office environment factors (stuffy atmosphere, variable temperature, cold/draughts), as well as age, were not confirmed. The major differences occurring were with the paths to ILLNESS1 and ILLNESS4. The majority of the paths which occurred in both models where of a similar magnitude.

14.4.4 A similar situation occurs for the affective measures at the pre-implementation stage. (Diagrams 14.2 and 14.19). The random sample model drops one path to Stress (chair), one to Participation (friendship), and one to Job Satisfaction (age); though the latter also has a new path (stuffy atmosphere). The comparison of the interactive models for the paths from the demographic variables at the pre-implementation stage (diagrams 14.3 and 14.20), shows four paths dropped in the random sample analysis; age-desk, sex-noise, job level-friendship and light.

14.4.5 The paths in the post-implementation model (diagram 14.4) reflect the relationship of the VDT and computer system parameters to the ILLNESS factors and affective variables. The random sample analysis continues to indicate these relationships (diagram 14.21), though there are a number of paths which disappear from the random sample model. On the other hand however, the VDT and computer system factors are still related to the criterion variables. It is, on the whole, the paths from the other variables which have fallen from the model; sex, autonomy, chair, and desk to ILLNESS1; Stress and task significance to ILLNESS2; chair, sex, and Stress to ILLNESS3; sex, age, and VDTERM2 to ILLNESS4.

14.4.6 Stress remains with paths from Job Satisfaction, Noise and Friendship, accounting for 46% of the variance. Participation loses paths from age and dealing with others, whilst Job Satisfaction has only Variety and age being linked by direct paths, due to the other four variables in the full model not being retained (diagrams 14.5 and 14.22). More numerous differences have resulted from the comparison of the two path models, illustrating the relationships that the demographic variables have with the job characteristics, office environment, and VDT and computer attributes (diagrams 14.6a-c and 14.23). These changes underline the caution with which this area of the results should be viewed, because of the low level of predicted variance; the majority of the items being below 12%.

14.4.7 A comparison of the two analyses, the data from all the respondents and the random sample, found most of the predicted variance remaining the same. Table 14.11 shows that

only four of the fourteen comparisons have more than a 5% difference; ILLNESS1 and Job Satisfaction at the pre-implementation stage, ILLNESS2 and ILLNESS3 at the post-implementation stage. There is the question with the use of this recursive model, that account has not been taken of reciprocal relationships that may well exist. Such possibilities have been commented upon elsewhere, such as the perceptions of respondents with high levels of job satisfaction generally report more favourably on their work environment than those with low levels of job satisfaction (Sundstrom 1986). Such reciprocity and feedback loops need to be built into future applications of the model. The application of the random sample to the analysis of the model has gone some way to validating the model, but the future use of the model, with data from another sample of respondents, would possibly add greater confidence in its application.

Table 14.11. A comparison of the predicted variance of the criterion variables in the Interactive Model

Criterion	Pre-Implementation Model		Post-Implementation Model	
	Full Sample %	Random Sample %	Full Sample %	Random Sample %
ILLNESS 1	27	18	33	34
ILLNESS 2	21	24	31	38
ILLNESS 3	10	12	17	23
ILLNESS 4	28	27	24	27
STRESS	44	41	46	46
PARTICIPATION	48	43	42	42
JOB SATISFACTION	37	46	36	33

15 DISCUSSION

Chapter Summary

The findings of the different analyses are discussed after threats to the validity of the study are considered. The implications of the findings in respect of the main attitude variables, the man-machine interactions, user well-being, and perceptions of the office environment are discussed. The possibilities for future research are suggested.

15.1 INTRODUCTION

15.1.1 The major purpose of this study was to evaluate introducing visual display terminals, into the offices of a UK government department and the effects they have on the level of job satisfaction, stress and health outcomes of traditional office workers. The design of the study allowed for a comparison of the situation found on several measures prior to the respondents working with VDTs and the position found approximately one year after they had commenced using the VDTs. Four different sites were surveyed in a single government department, with different levels of management and clerical staff completing the self completed questionnaires. As was found in the examination of the previous published studies, there are many methodological threats to the validity of the findings of any study. It is worthwhile therefore to examine those that appertain to this field study before the findings are discussed.

15.2 THREATS TO VALIDITY

15.2.1 The fundamental approach was to improve on the cross sectional design, previously used almost exclusively in field studies, into the impact of the use of VDTs, and follow a longitudinal design. This design has been regularly advocated by several reviewers of the literature in this area of research, however, it is recognised that in order to be a more powerful design, a further stage of data collection would be a distinct advantage. However, the pragmatic considerations of the time constraints on taking further measures had to win the day. The possibility that other changes have occurred during the period between the two measurement stages, which are not the subject of measurement, cannot be totally ruled out. The control groups, though, assist in reducing the possibility of incorrect inferences being drawn.

15.2.2 As with many other field studies, the groups of respondents were non-randomly selected. The respondents were self-selecting through voluntary completion of the questionnaire from opportunity sites. The rate of response for the whole survey was 71% at the pre-implementation stage and 68% at the post-implementation stage. The rate of response varied across the sites, with CHBC at Stage 1 and RD at Stage 2 being the lowest (54.8% and 56.9% respectively). A reasonable amount of confidence in the respondents being representative of the site populations was obtained from the chi-square test on the age and gender distribution of the respondents, which found only the CHBC respondents had a significant difference in the age distribution. This leaves some doubt about the representative nature of the respondents

at CHBC. However, the results obtained on a number of the measures coincides with findings in other research results into the study of organisations, eg, those with longer service in the organisation were found to have greater job satisfaction (Lee and Wilbur 1985).

15.2.3 The occupational position and role gives rise to different perceptions and this parameter is often not made clear in reports of field surveys, despite the job title being given. The assumption appears to be made that if the job title is the same, the perceptions of title holders across organisations will be similar. The same title can mean different experiences in different organisations, so the analysis of this survey's data took the occupational level into account. This information was facilitated by the researcher's knowledge of the work content of the clerical groups at CHBC and OG being different, as well as relying on the job level categories completed by the respondents. The other personal characteristics of age, gender, length of service and educational qualifications were also used in the data analysis. These characteristics were examined with the outcome variables because the users will bring with them a variety of experiences and perceptions which have been found to influence the relationship of the independent variables to the outcome variables.

15.2.4 Variations in the location attributes can produce systematic differences among the total population. The reactions to the different buildings has been taken into account through the individual site analysis. The differences in the main parameters of the office environment were found to

influence people's perception, so the factorised variables were built into the path analysis model along with the workstation variables.

15.2.5 The introduction of VDTs into these offices is a new situation for the majority of the users, but there were those who had worked with computers before, either in other employment or in their education. Those who have prior knowledge may respond to the survey in different ways, and, in addition, these respondents will have formed a view about how they like or dislike working with computers. Depending on the direction of that disposition, it is likely that there will be a different reaction to the new system, and in particular, that is likely to be reflected in the responses to the questions at Section 5 of the questionnaire. The analysis took account of this possibility and examined the data for any differences between the respondents with and without former computer experience.

15.2.6 There are other possible systematic differences in the responses which could skew the overall data. These could arise out of the respondents individual differences and experiences such as personality, skills, training, and the interest they have in new technology. It is, however, not practical to control for all potential threats but the most pertinent ones have been mentioned above.

15.2.7 In the current study the measures have all been self-completed by the respondents. The levels of reliability for the JCI and attitude variables were found to be very satisfactory and were reported on in Section 4 (4.4.9). On the other hand the office environment and computer system factors

were less reliable and could have contributed to inappropriate conclusions being drawn, particularly when applied to the path analysis model. This calls for some caution in the interpretation of the results and suggetions are made later on for some possible alternative measures or the development of more acceptable self-completed measures. Glick, Jenkins, and Gupta (1986) discussed the issue of common method effects (how the relationships between variables are affected by the use of single source data, eg self-completed questionnaires) particularly with regard to the relationship between job characteristics and affective outcomes. They commented that "it is individual perceptions and attitudes that ultimately determine employees' responses to work environments, self-reports may be a valid and useful source of data". They did, however, find a drop in the strength of the relationship between job characteristics and satisfaction after extracting common method effects and therefore suggested it would be desirable where possible to use multiple method measures.

15.3 THE POSITION BEFORE THE INTRODUCTION OF THE VDTS

15.3.1 The results indicate that for this population of white collar staff, in a government department, working on traditional office, tasks there are links between the office environment, their job characteristics and job satisfaction. This impacts upon their health and well-being to a significant degree. The respondents show an increase in their levels of job satisfaction the longer they have been in their careers. The clerical staff have less job satisfaction and the younger age workers in these groups report the greatest degree of job stress. It is interesting to find that the more senior job

levels, and those who have been in the civil service for a greater length of time, see their jobs as having more variety and report a greater degree of participation in decision making. This agrees with the results obtained by Katz (1978). Previous findings have also linked age and job satisfaction as well as longevity of job tenure (Lee and Wilbur 1985, Mottaz 1987). The combination of low levels of decision making and restrictive job characteristics have been found to be associated with mental strain (Karasek, 1979) and this may explain the higher reported stress among the lower grade, younger aged group, particularly at CHBC and OG. There is no doubt that taking the JCI scores as the indicator of the quality of the job, that those with the least satisfaction are the clerical staff. This situation is the result of fragmentation and grade specialisation through a Tayloristic approach to job design. Also the path analysis proposes that job satisfaction has a strong inverse relationship with stress and Wall et al (1978) report a stronger association between job satisfaction and the GHQ than with the core characteristics of the job characteristics model (JCM).

15.3.2 There is some degree of confirmation of the links between the dimensions of the job characteristics model and the job satisfaction measure found by other studies (Brief and Aldag 1978, Katz 1978), although the correlations are not as high in this study, with autonomy and friendship being non-significant. Autonomy had a clear link with the participation measure in the path model, but the interpersonal relationship dimensions also had relatively strong links with job satisfaction, as well as with participation. Variety was a key factor for the development of job satisfaction having the

highest path coefficient of the related variables. The level of job satisfaction for the total sample in the study lies below that found by the instrument's authors for a general group of American female office workers. Interestingly, however,it is at the same level as that found by Bell (1986) in a study of the Northern Ireland Civil Service.

15.3.3 From the respondents' reports ill-health appears to be quite prevalent for some symptoms, with between approximately 20% and 30% indicating musculo-skeletal discomfort, visual problems and headaches (rated from "often" to "always"). These levels of discomfort and ill-health are lower than some reports for other traditional office workers (Hedge 1982, 1984) but similar to others (Stellman et al 1987). The difference in results may be partly explained by the use of different response scales; this study and Stellman et al (1987) used frequency of occurrence, whilst Hedge (1982) used an agreement scale. The results also indicate a clear association between job satisfaction, participation, the level of stress and visual health factors, though this direct relationship is not true for the hand/wrist, psychosomatic ailments or musculo-skeletal ailments.

15.3.4 The reactions to the office environment were not as adverse as found in some studies. Hedge (1982) found between 45% and 55% were distracted or interrupted in their work by telephones or conversation, compared with 21% in this study, while office machines were a disturbance for 34% compared with only 3% in this sample. In keeping with Sundstrom's study (Sundstrom, 1986), a significant relationship was found between how comfortable office workers find the office

temperature and the attitudinal responses to job satisfaction, participation and stress. Experiencing comfortable temperatures in the office is almost as strong a predictor of job satisfaction as variety. The age of the office worker also appears to be mediating the relationship between job satisfaction and the office environment. The younger age groups have less job satisfaction and this in turn leads to a lower level of satisfaction with the office environment; a suggestion put forward by Sundstrom (1986) following his studies into office environments. It was also found that overall the level of comfort found with the office ambient temperature and a non-stuffy atmosphere had a significant relationship with job satisfaction and is in keeping with previous research into office workers perceptions of various environmental facets of the office (Ferguson and Weisman, 1986).

15.3.5 There are also intercorrelations between the health factors and two of the environmental factors. If ambient temperatures are regarded as less than satisfactory there is an association with a greater amount of musculo-skeletal and visual health factors, whilst feeling cold and draughts emerged as important to an increase in hand/wrist aches and the psychosomatic complaints. Being affected by musculo-skeletal discomfort and psycho-somatic complaints is more likely for women. A review of nineteen studies, that investigated gender differences in stress symptoms, concluded that women tend to exhibit lower emotional well-being than men, but the evidence is not conclusive and more research is required (Jick and Mitz 1985). The covariance of gender and job level throughout the findings of this study does, however,

job level throughout the findings of this study does, however, suggest that there is a need to view the link between the musculo-skeletal and psycho-somatic symptoms and gender with some caution. Kasl (1983) indicates that there is a distinct need for more research to be undertaken into the apparently changing level of risk for women in employment; as the incidence of women in work grows there has been an indication that their level of ill-health has increased.

15.3.6 The path analysis found the greater the amount of autonomy and dealing with others that the individual, has and the less they seek friendship in their work, the greater the level of participation they report. The degree of participation is also influenced by the level of comfort that is achieved in the office environment. The level of comfort is strongly influenced by the absence of variations in temperature and a low level of noise distraction. There would appear to be no immediate reason for expecting this result, except that if the office temperature is experienced as constant and at a comfortable level with less noise distractions it could assist in generating feelings of more control over the office environment than would the reverse position. Job satisfaction is also influenced by the office climatic conditions which, in many studies into job satisfaction and stress, are not explored and clearly from these results is an important set of variables which require taking into account.

15.3.7 If the proposed model reflects the current situation in these offices, attention needs to be paid to the office

This is because indirectly these influence the level of stress which is experienced and the musculo-skeletal and visual health problems. However, no account was taken of whether self-reported illness manifests itself in increased sick leave or absenteeism and further enquiries are necessary to check this.

15.4 JOB CHARACTERISTICS,JOB SATISFACTION AND PARTICIPATION WHEN WORKING WITH THE VDT

15.4.1 One of the most important findings in the data analysis was that no statistically significant difference occurred in the job characteristic measures between the two stages of measurement. As discussed at paragraph 11.3.6 this is probably due to the majority of the users spending a relatively small proportion of time on the VDT, 74.7% for less than two hours a day, and the limited functions that were available to the users at two of the sites did not allow development of the jobs to occur. The office support systems at OCAO and RD were still being developed and skills being learned, even after 11 months use. This was particularly true of the system at OCAO, where the main need perceived by the professional authors for a data base of legal case precedents had not been produced. A third reason could be the method of enquiry into the job content, this focused on the attitudinal reaction to the job whereas with hindsight a more detailed task analysis, such as the Job Components Inventory (Banks et al 1979) or Hierarchical Task Analysis (Patrick et al 1985) would have defined the jobs at the task and sub-task level and possibly established changes occurring. It is of importance, however, that the motivational quality of the jobs are

explored and the two methodologies would be complementary in any further study.

15.4.2 The post-implementation path models had direct paths from some of the job characteristics; from autonomy and dealing with others to participation, and variety to job satisfaction. As was noted from the pre-implementation data, there was a correlation between the amount of variety and the level of the job holder and this was confirmed in the post-implementation path model. The indications from previous research is that the poorer jobs of the more junior levels in the organisation deteriorate even further with the introduction of the VDTs, often becoming more monotonous and boring. There was therefore a reasonable concern, prior to working with the VDTs, that they would further impoverish the lower level jobs through deskilling, making them more machine paced, and the computer taking over some of the decision making and checking functions. This picture did not materialise, even though the expectations of the managers at two of the sites, CHBC and OG, were that the change in work procedures and the integration of a limited service from the computer would marginally improve the clerical jobs. The managers did not have any model of job design which they applied, and given even a moderate input of guidance and advice in this area of knowledge, the outcomes could have been more positive. To have gone further and used a more detailed and thorough socio-technical process for developing the jobs, in conjunction with the introduction of an on-line system, would have provided improvements at those two sites in particular. Having said that, there was no concern over the impact on the motivational aspects of the user's jobs, or the

organisational opportunities for change that the systems could give, at OCAO and RD and opportunities were also not taken there.

15.4.3 Even though there had been different strategies used at each site for the involvement of the users in the change process, from very little involvement at OG to a high degree of user representative input in decision making groups at OCAO, it emerged, for the respondents who completed the questionnaire at both stages, that an improvement in the participation score had occurred at a statistically significant level for the total population. In addition there was only significant changes found at CHBC, and not the other sites, on the job satisfaction measure. There was virtually no difference in the job satisfaction score for the respondents who had completed the questionnaire at both stages.

15.4.4 The finding that there was no deterioration in the job satisfaction score of the VDT users is consistent with the results of other field surveys, which suggested that no lower job satisfaction occurred among the users than the non-users. Starr et al (1981) found indications of a minor increase in satisfaction, whilst Coe et al (1980) considered the users and non-users had their satisfaction needs met.

15.4.5 The definition of job satisfaction has not any universal agreement, but Locke (1969) regarded it as multi-dimensional which encapsulates "the pleasurable emotional state resulting from appraisal of one's job as achieving or facilitating the achievement of one's job values". The main "ingredients" for these subjects are the two job characteristics, variety and dealing with others, as well as

the influence of age and job level, which were discussed above. The antecedent variables in the path model for job satisfaction were unchanged from Stage 1 to 2 except the office environmental factor, comfortable temperature, was replaced by the VDT factors concerned with the reliability of the system and its functionality. The antecedent variables accounted for 47% of the variance at the post- implementation stage. If there is to be an improvement in the level of job satisfaction, particularly for the lower grades, it would be worthwhile considering how the variety in the jobs can be developed; the managers/professionals interactive model indicating variety with a direct path to job satisfaction but not for the clerical/typist grades. Fortunately, no decline occurred in the amount of variety after the introduction of the VDTs. The question of variety could be linked to the aspects of the job which bring more interpersonal relationships into play so that the dimension of dealing with others is also enhanced. Even though many of the jobs examined in this survey do not deal directly with the public, the development of relationships through the concept of "internal" customers (Deming 1986) and stronger team working (Wall and Clegg 1981) would most probably enhance these job dimensions.

15.5 MAN-MACHINE INTERACTION

15.5.1 The findings from the data for the four sites was dealt with in some detail in section 11.2 and a picture emerged of the time users spend working on the machine is on the whole quite modest, with approximately 60% or more spending less than 2 hours a day on the VDT. Only a few studies had examined the differences in the level of VDT use,

though the longer term users have been regarded as being at greater risk (Dy 1985, Evans 1985). The findings here are the reverse, where the higher user group were found to have greater job satisfaction and job variety scores. The path model shows the time spent during the day on the VDT was influenced in a minor way by the user's age and job level, accounting for 5% of the variance. The data from this study would appear to suggest that there is an inverted U relationship between the amount of daily use and job satisfaction; very minimal users not having as great a degree of satisfaction as moderate users and high users having poor rates of satisfaction. A similar conclusion was reached by Khan (1987) with regard to the motivating potential score of the JDS in his study of the travel agent users. This is probably complicated, however, by the content of the high users job; not being as detrimental to high users in better quality jobs but adversely affecting those in the high data input type of work.

15.5.2 As was suggested by Sundstrom (1986) with regard to worker's perception of the office environment, there may also be a similar mechanism at work with regard to the perception of problems with the VDT and computer system, ie those with low job satisfaction have more dissatisfaction with the computer system and VDT. The dichotomised job satisfaction scores in this survey indicated this may apply with the high job satisfaction group considering they had fewer breakdowns and better servicing as well as more business -like assistance from the computer. This must be regarded as a tentative conclusion and a more thorough examination is required.

15.5.3 The complaints from users, about ocular related aspects of using the VDT, were less than other studies (see 11.2.7) but there was considerable dissatisfaction with the performance of the computers at CHBC and OG over the reliability of the system and at OCAO and RD over the system response times. The reason for the poor performance, in the case of the former sites, could well be the large complex computer system with groups of different users on several sites having the greater potential for breakdown. In the case of OCAO and RD on the other hand, it was a combination of software functions and the number of users to the size of the central processor. The users' views on the functionality and reliability of the system were predictor variables in the path model for job satisfaction, though they only contributed 13% and 3% respectively to the variance. Reliability of the system also contributed 9% to the variance of the participation score.

15.5.4 These findings confirm the conclusions drawn from a survey of 530 users in 55 offices by the Rand Corporation researchers (Bikson and Gutek 1983). They found four aspects of computer systems underlying user satisfaction of the computer; functionality, equipment reliability, interaction features, and office environment. These factors were generated by factorial analysis of their data. The items which contributed to the functionality factor were: text or data alteration capability, text or data entry capability, organisation of stored information, information retrieval capability, appropriateness to the job functions, error detection and correction, back-up facilities,and keyboard layout. These do not correspond directly with the three items

that constituted the functionality factor that emerged from the factorial analysis of this study's data. The issue here appears to be analogous to the overlapping concept of usability discussed by Eason (1984), and later Briggs (1987), whereby there is a need to reach an agreed scientific definition and operational form of measurement.

15.6 PERCEPTIONS OF THE OFFICE ENVIRONMENT

15.6.1 The outcome of the enquiry into the work environment problems must be viewed more cautiously than the other aspects of the study, due to the relatively low reliability coefficients obtained for the office environment measures. There was, however, found to be a building specific response to these measures which confirmed in many instances the experiential knowledge of the management, users and trade union representatives that commented on these issues. The measurement of the office environment by objective measures would have provided a means of establishing whether any of the parameters did change and how the subjective data compared with the respondents perceptions. Goacher (1980) refers to a study by Tragenza et al (1974) investigating the correlation between subjective and objective assessments of the office lighting which suggested that subjective assessments could be reliable and valid. Whether the same conclusion could be reached about other ambient conditions is open to exploration.

15.6.2 The findings from the pre- and post-implementation comparisons found only a small number of statistically significant differences. For example, the comfort of the

temperature was perceived as having deteriorated. This does not diminish the consistent view of a high incidence of undesirable environmental problems, eg as high as 60% finding the ventilation unsatisfactory. The larger proportion of women in the sample would raise the incidence of dissatisfaction because women have been shown previously to report more symptoms than men (Hedge 1984). There was no specific comparison analysis made of the possible differences between the main job levels, but one would expect there to be different perceptions and assessments of the office attributes by managers, who have different rooms and space standards to work in, than the clerical and secretarial grades in large open plan rooms. The path model had both age and job level linked by direct paths to two of the environmental factors, which indicates confirmation of other research pointing to job level relationships (Ferguson and Weisman 1986). There would also be the influence of the degree of job satisfaction, as well as other organisational parameters which mediate the responses.

15.6.3 The focus of a great deal of the research into VDT use has been into the relationship of the ambient lighting and reports of visual problems. There was less satisfaction for the quality of the ambient lighting at CHBC and OG than at OCAO and RD. However, even at CHBC and OG the proportion of the respondents expressing dissatisfaction was much lower than with former studies; often reports of as high as 65%-80% (eg Goacher 1980, Stammerjohn et al 1981). One of the sites, OCAO, had an improvement in the incidence of satisfaction with the lighting at the post-implementation stage. This was probably due to the installation of improved lighting for the VDTs

after the pre-implementation measures had been completed. Otherwise there was not any significant change found in the respondents' perceptions between the scores at the two stages. Despite it being desirable to have objectively measured the lighting levels as part of the survey, the management when approached to carry this out decided against it. Despite the reassurance of the conclusions of Tragenza et al (1974), referred to earlier, it would add an important dimension to the methodology to have the lighting accurately measured so that any changes in the lighting levels due to the upgrading of the illuminaries could be taken into account with the perceptual data.

15.6.4 A further factor, in the differences in the perceptions of the adequacy of the lighting, could be the greater proximity of respondents to the windows in the OCAO and RD buildings. Smaller cellular rooms were the main type of accommodation and the studies have found a preference for natural daylight among office workers (Hedge 1982, Sundstrom 1986). Sundstrom (1986) reports the BOSTI project (1981) finding a connection between the intensity of the lighting and the satisfaction with the office environment. This does not appear to translate directly to general job satisfaction in this study as there wasn't a direct path from lighting to job satisfaction in the path model; the data was not examined to see if there was any correlations between environmental variables and the attitude variables. On the other hand, Fried and Ferris (1987) found 31% of the variance of work satisfaction, as measured by nine items from the JDS (Hackman and Oldham 1975), could be accounted for by the workplace characteristics. The differences in the overall responses

concerning lighting would appear to be influenced, as with the other environmental variables, by the different job levels; the greater dissatisfaction with the lighting occurring at CHBC and OG where the greater proportion of the clerical grades are located.

15.6.5 Both CHBC and OG were open plan offices and it was a feature of the survey that the incidence of distraction from internal noise was very low at the former, and for OG a similar score to the other two sites at the post-implementation stage. The amount of internal distractions in other studies have been found to be higher, particularly in open plan offices (Hedge 1982). Noise was one of the variables with a direct path to stress in the post- implementation model. Sundstrom (1986) reports on a number of studies relating noise with dissatisfaction over other elements in the office environment and job satisfaction. Office workers, in substantial numbers, report distraction due to noise being a problem (Ferguson and Weisman 1986) so this population does not appear untypical and the VDTs did not produce any consistent deterioration in the position.

15.6.6 The perceptions of workstation comfort were tested with only single questions about the chair and desk comfort. The only statistically significant change was found at OG where the desk was too small to accommodate the papers satisfactorily after the VDTs arrived. As reported at section 4.5, the standard of the workstations, whilst open to improvement at RD in particular, were on the whole of a reasonable standard as gauged by the ergonomic checklist. The respondents at CHBC and OG had a poorer opinion of their chair

than the other two sites, which were comparable to a large survey conducted in the United States when 84% said they had comfortable chairs (Sundstrom 1986).

15.6.7 The results of this, and other studies, suggest that the various characteristics of the broader physical environment have an important impact on the attitudinal reactions of office workers. In this study not all the dimensions and characteristics of the office environment were measured, so there may well be some other significant characteristics which contribute to the degree of job satisfaction. It is of particular note, however, that the post-implementation path model had two of the computer system factors, reliability and functionality, replace the environmental factor, comfortable temperatures, as a predictor variable of job satisfaction. More reliable measures require development to explore the impact of the office environment on VDT users' perceptions and attitudes. This would be strengthened by being used in conjunction with objective measures, in order to differentiate the causal contribution of these variables from the VDT and computer variables.

15.7 THE WELL-BEING OF THE VDT USER

15.7.1 The results of the pre-implementation data indicated that traditional office workers contend with environmental, job design and organisational stressors which impact in a multi-causal manner. The examination of the data attempted to arrive at some understanding of the antecedents of the physiological and psychological health outcomes. At one time, in the understanding of the concept of stress, it was assumed

that specific individual stressors depend upon the type of stressor involved. However, Selye (1956) proposed that different stressors produce similar physiological and psychological reactions and the health outcomes will be different for each individual because of genetic and psycho-social differences. Research into occupational stress has used this concept, of the individual dealing with stress in that person's total work system, and has tried to isolate the particular aspects of the system which are sources of stress, or have potential to produce stress (Cooper 1986). The introduction of the computer into the office worker's environment alters parts of this office system. Systemic theory suggests that if one part of the whole is altered the remaining parts will be affected (Checkland 1972). The results of the pre-implementation survey indicate that, as measured by the GHQ12, many of the DSS managers and staff experience stress, so is there greater stress, and consequently an increase in the incidence of ill-health, following the major change of the introduction of the on-line computer systems?

15.7.2 The model, proposed as the basis for this study, considers the changes in the ill-health outcomes being the result of introducing VDTs and the inter-related changes in the office worker system. The examination of the main antecedent variables in the model had not found a great many changes in the measurements between the two stages. This was found to be the case for the 19 health symptoms, whether the analysis was on the data for the three or the four sites. There was a significant difference found for the GHQ12 between the two stages, but only for the data for the total respondents at the three sites and not for the respondents who

had completed the questionnaires on both occasions at these sites. This limited result raises doubts for generalisation to other populations.

15.7.3 The incidence of the reported health symptoms was similar to other studies for the two large clerical samples at CHBC and OG, but lower at the other two sites. This suggests a job level influence, though the path model analysis did not indicate any direct paths from job level to the ILLNESS or stress variables. There was a direct path from gender to two of the outcomes, ILLNESS 1 and ILLNESS 2, at both measurement stages. However, when the separate analysis was conducted for men and women, job level still did not feature as a direct path. The discussion at 15.3.5 concerning the gender difference in the self-reporting of health symptoms is therefore pertinent to the post-implementation position as well. The direct paths were similar for the illness factors when the path analysis was conducted on the dichotomised job groups (managers/ professionals vs clerical/typist group) as for the gender analysis, but could be a result confounded by the small number of women in the management group.

15.7.4 Variety is an important job characteristic in the model at the post-implementation stage, for both the visual and musculo-skeletal factors, indicating confirmation of the links that have been suggested in a number of former studies (Gunnarsson and Ostberg 1977, Buchanan and Boddy 1980, Cakir et al 1980, Johansson and Aronsson 1980, Ghiringhelli 1980, Hunting et al 1981, Wright 1987, Stellman 1987). Despite the finding that the perception of variety in their jobs had not changed over the period of the study, deficiency of this job

characteristic was an important predictor of two of the illness factors when the VDTs were being used. This again points to the importance of ensuring the job design issues are taken into account when IT is introduced, particularly at the lower grades, and the importance of examining the amount of variety in the jobs in order to avoid the monotony and boredom reported by many users.

15.7.5 Stress featured as an antecedent variable of all the illness factors at both stages, with the exception of ILLNESS 1 - the musculo-skeletal factor. There was also, on the whole, consistency in the post-implementation model of the VDT/computer or workstation characteristics featuring as significant antecedent variables to these factors. As was found with the antecedent variables to job satisfaction and participation, the office environmental factors ceased to have direct paths to the ILLNESS factors in the post-implementation model. This appears to mean that, after adjusting for the effects of other variables in the model, the VDT/computer and workstation variables are significant in predicting the health outcomes of the model.

15.7.6 Another important area of confirmation with previous research is the direct paths found between the satisfaction of the lighting and the visual illness factor. The attention paid to improving lighting levels, and a better design of workstation when computer systems are introduced, are important considerations to reduce the risk to office workers of musculo-skeletal and visual problems. In view of the direct paths in the model from the VDT screen characteristic's factor, and the musculo-skeletal, visual and the hand/wrist

illness factors, the model also supports the emphasis of the literature advocating avoidance of problems associated with VDT's screen characteristics.

15.7.7 A correlation was found in some earlier studies between the amount of VDT use and the incidence of reported ill-health (Gunnarsson and Soderberg 1980, Haider et al 1980, Dainoff et al 1981, Elias et al 1980), but there was only one site in the present study having significant differences between the high and low user groups. Extensive users at RD had more visual symptoms and back pain, but this was not reflected in the data from OCAO, where the pattern of useage was almost identical. The aggregated data for all the sites indicates more of an agreement with the conclusion of Smith et al (1982), that there was no relationship found between the incidence of eye discomfort and the duration of daily work on the VDT, though it must be said with some caution because of the generally low level of use among this population. Due to the low pre-implementation base line of health symptoms occurring among the clerical job holders at CHBC and OG, and at the post-implementation stage being the more infrequent users, the VDT use variable may well be confounded by the nature of the jobs.

15.7.8 As regards the health risks of VDT users, the present findings are consistent with several previous studies (Coe et al 1980, Starr et al 1982, Campbell and Durden 1983, De Groot and Kamphius 1983, Howarth and Istance 1985, Zeier et al 1987). There is little evidence that the current subjects suffer greater health risks than they did prior to the introduction of the VDTs. After the introduction of the VDTs,

the users did not report significantly greater health and stress problems and are in contrast to the results of many other comparative studies (Cakir et al 1980, Ghiringhelli 1980, Laubli et al 1980, Elias et al 1980, Hunting et al 1980, Smith et al 1981, Stammerjohn et al 1981, Rowland 1984, Levy and Ramberg 1987, Stellman et al 1987, Wright 1987), indicating visual and musculo-skeletal problems occur more frequently among VDT users than the non-users.

15.7.9 Finally, the findings clearly indicate that the staff in government offices have to contend with annoyance and dissatisfaction, leading to increased levels of stress and ill health, regardless of whether they are working with a VDT. The physical conditions experienced in the office are difficult to resolve to the satisfaction of everyone. However, if not attended to they could give an increased feeling of lack of control and become a focal point for disgruntlement. Strategies need to be considered which present more opportunity for the junior staff in particular to be given greater involvement in decision making about their jobs, and thereby an enhanced feeling of control over their working lives. An important contribution to greater control over the office environment would be individual workstation lighting, adjustable desks as well as chairs, and involvement in the layout of the office furniture. Also the design of jobs needs improvement in order to enhance job satisfaction, this would be a contribution to the reduction of stress and ill health. Perhaps an important implication of this study is that the mechanisms for stress and ill-health have a great many similarities for users and non-users alike. After taking into account the predictor variables in this model of ill-health,

there clearly exist other influences which bear on ill-health, stress, and job satisfaction since about 65% to 80% of the illness factors, 55% of the stress, and 64% of the job satisfaction measures are unaccounted for with the proposed model.

15.8 FUTURE RESEARCH

15.8.1 The study has drawn upon four opportunity sites within a government department, drawing data from a single organisation of clerical office workers. This has assisted in keeping a homogeneity of organisational culture and management styles, reducing the possibility of confounding factors when comparing sites. The survey design has used a number of reliable measures, and a control group, in conjunction with the "before and after" design, in order to derive, some greater understanding of the changes that occur over time in a major technological change situation. The analysis drew upon a model which endeavoured to capture the complexities of the office worker's situation and to define some causal relationships. Despite the survey having taken place in a single organisation, the model has given an integrated structure to office worker's conceptualisations of their work situation.

15.8.2 It is important to improve on the taxonomies for the descriptions of VDT clerical work. The activity-time matrix suggested by Staehle et al (1984) would be a useful starting point, which would identify the cluster of jobs that share common features such as word processing as the main activity. There will probably be further refinements required to take

account of other characteristics which could form sub-clusters; for example, the time spent viewing the screen, the work schedule, and the cognitive requirements. In order to establish what the variables might be which would constitute a taxonomy, the application of the Jobs Components Inventory (Banks et al 1979) or Hierarchical Task Analysis (Patrick et al 1985) would be possible tools of enquiry. There would still be a place to link this detailed understanding of the content of jobs to the perceptual measures, such as the JCI, because of the need to obtain understanding of the links with the affective responses to the different descriptions.

15.8.3 In conjunction with the more detailed job analysis suggested above, account needs to be taken, in the samples selected, of a range of times spent on the VDTs so that similar job descriptions can be compared with different scales of VDT use. The higher "exposure" users of office support systems need to be included in greater numbers. A possible contributory factor to these findings, indicating that there was minimal influence due to the change, was the small amount of time spent by many of the users on the VDTs, so the population was not representative of the VDT users as a whole. The two office support systems were still being developed and there was every likelihood that the users would spend greater amounts of time on the VDTs as time progressed. A further measurement point would be valuable for two reasons; firstly to assess further growth in the use of a system from the initial introduction, and secondly a further measurement point would add greatly to confidence in causal mechanisms implied within the interactive model.

15.8.4 In this study there was an absence of any objective measurement of ill-health. If absence records could be obtained or the application of physiological measures, such as adopted by Johansson and Aronnson (1980), the possible shortcomings of common method measurement would be reduced, and correlations explored with the combined job task and job characteristic measures. Even though the findings from this study indicate that the introduction of working with VDTs did not bring any greater potential for ill-health, the additional information may add strength to the findings relating to the aetiology of office workers' ill-health.

15.8.5 The alpha coefficients of the measures for the office environment were lower than is desirable and raise doubts about their inclusion in the analysis, and in particular in the path model. This needs to rectified through the use of some objective measures, eg, temperature, humidity, lighting and noise, which could be correlated with the subjective responses to the environment. The subjective scales also require development to a more acceptable level of reliability. Furthermore, the user reactions to the computer systems require more thorough identification, so that sound and agreed scientific definition of these dimensions, among them functionality and useability, can be applied and together with the environmental characteristics, predict overall satisfaction and the relationship to stress and ill-health.

15.8.6 The interaction model included only one parameter of organisational attributes, ie participation. In conducting the research the comments received from line managers, trade union officials, systems managers leading the projects, indicated the need to include measures that would reflect the user's

perceptions and interpretation of the organisational climate. The findings suggest that the most critical problems, in implementing and working with new technology for the users, are not technological ones. Instead they are the characteristics of the organisation and how it organises and structures work, irrespective of the technology, and how it deals with the employees' needs in the total work environment.

15.9 FINAL CONCLUSION

15.9.1 The data from this survey indicates that there is no deterioration for this group of office workers following the introduction of on-line computer systems. There was little evidence found of a deterioration in the perceptions of their job characteristics and general job satisfaction. However, it was found that working with the VDTs was helpful in carrying out the work tasks.

15.9.2 The "before and after" methodology adopted adds strength to the general findings. The results have made it apparent that the proposed model was a friutful method for understanding the multi-variate nature of the office workers' experience. The model also successfully facilitated some understanding of the changes brought about in the complex person-environment relationships. It was a particularly significant finding that the path model found the VDT/computer and workstation variables replacing the office environmental factors in the path model at the post-implementation stage. In addition, these were found to be significant in predicting the health outcomes.

15.9.3 The statistically significant relationships found in the workers' evaluation of the office environment, and attitudes to the job content and job satisfaction, has confirmed a number of findings in previous research. Worthy of note in this context are the paths in the model linking the VDT screen characteristics with the musculo-skeletal, hand/wrist, and visual illness factors at both the pre- and post-implementation surveys. This gives confidence in the application of the model as well as pointing to areas for future enquiry.

15.9.4 The development of the model has indicated the need to examine the systemic, interactive nature of the office workers' perceptions of their total work situation and thereby padded, in a small way, to the evaluation and understanding of VDT work for government offive workers in particular, and VDT work in general.

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APPENDIX 1a

PILOT QUESTIONNAIRE

OFFICE WORK SURVEY

This survey is being used to examine the relationship between various elements of an office employee's job and the effects they have upon the individual.

Your assistance in completing the following questions as accurately as possible is very much appreciated.

Your answers will be treated in complete confidence.

Site Group Number

For Official Use

SECTION 1: BACKGROUND INFORMATION

1 How long have you worked in the Civil Service?

6	C
Years	Months

2 How long have you worked in your present office?

1	3
Years	Months

3 How old are you? (Please circle a number 1-6)

Under 19	1
20 - 29	2
30 - 39	(3)
40 - 49	4
50 - 59	5
60 or Over	6

4 How would you describe the type of work you do? (Please circle a number)

Managerial	1
Professional/Specialist	2
Clerical	(3)
Secretarial	4
Other (Please specify)	5

.....

5 What is your Civil Service grade? Grade CO

6 What is your sex? (Please circle a number)

Female	1
Male	(2)

For Official Use

7 What is your highest level of educational attainment?
(Please circle a number)

None	1
CSE/'O' level	2
'A' level	(3)
Degree	4
Post graduate degree	5
Professional qualification	6
(please state)	7

		Yes	No
8 When in the office do you wear: (please circle a number)	Spectacles	1	(2)
	Contact Lenses	1	(2)

SECTION 2: ENVIRONMENTAL CONDITIONS

This section of the questionnaire asks you to consider how satisfactory you find your work area (that in which you spend the most time.) Please indicate your answer by circling a number on each scale (Winter and Summer) which represents your feelings.

1 How would you describe typical working conditions in the office in WINTER?

At my work place in the office I find that:

	Never	Occas-ionally	Often	Very Often	Always
- it is too warm	1	(2)	3	4	5
- it is comfortable	1	2	3	(4)	5
- it is too cold	1	(2)	3	4	5
- the temperature varies throughout the day	1	(2)	3	4	5
- the temperature remains constant throughout the day	1	2	3	(4)	5
- there is little air movement	1	2	(3)	4	5
- there are uncomfortable draughts	1	(2)	3	4	5
- the ventilation is satisfactory	1	2	(3)	4	5

For Official Use

2 How would you describe typical working conditions in the SUMMER?

	Never	Occas-ionally	Often	Very Often	Always
- it is too warm	1	(2)	3	4	5
- it is comfortable	1	2	3	(4)	5
- it is too cold	1	(2)	3	4	5
- the temperature varies throughout the day	1	(2)	3	4	5
- the temperature remains constant throughout the day	1	2	3	(4)	5
- there is little air movement	1	2	(3)	4	5
- there are uncomfortable draughts	1	(2)	3	4	5
- the ventilation is satisfactory	1	2	(3)	4	5

3 LIGHTING

At my workplace in the office I find that:

	Never	Occas-ionally	Often	Very Often	Always
- I have adequate daylight	1	2	3	4	(5)
- I am bothered by reflections or glare	(1)	2	3	4	(5)
- the lighting is too bright for comfort	(1)	2	3	4	(5)
- the lighting is satisfactory	1	2	3	4	(5)
- the lighting is too dull	(1)	2	3	4	5

For Official Use

4 NOISE

At my workplace in the office I find that:

	Never	Occas-ionally	Very Often	Often	Always
- it is too quiet	(1)	2	3	4	5
- I am distracted by noises in the office (talking, telephones)	1	(2)	3	4	5
- I am annoyed by noise from office machines (typewriters, etc)	1	(2)	3	4	5
- I am distracted from my work by outside noise	1	2	(3)	4	5

5 FURNITURE

At my workplace in the office I find that:

	Never	Occas-ionally	Very Often	Often	Always
- my desk is too low	(1)	2	3	4	5
- my chair is uncomfortable	1	2	(3)	4	5
- I find my chair gives me back and/or neck pains	1	2	(3)	4	5
- my desk is too high	(1)	2	3	4	5
- my desk is satisfactory	1	2	3	4	(5)
- my chair is comfortable	1	2	(3)	4	5

For Official Use

IF YOU WORK ON A VDU/WORD PROCESSOR PLEASE ANSWER THE FOLLOWING QUESTIONS. IF NOT PLEASE SKIP THIS SECTION AND CONTINUE WITH SECTION 3.

6 How many hours on an average day do you normally work at a VDU? (State number of hours) .....

7 What is the maximum amount of time spent continuously working at a VDU without a break* (State number of hours) .....

Note* A break means time both spent away from the VDU (and may include doing other work) as well as stopping for a rest period while at the VDU.

8 How many hours on an average day do you spend interacting with others (not including lunch time and only working hours)

(State number of hours .....

9 How much time on an average day do you spend:
(enter the number of hours in the box)

word processing

data input

programming

information retrieval

other (please specify)

10 Whilst using my VDU I find the following problems bothersome: (as before indicate your answer by circling a number).

	Never	Occasionally	Often	Very Often	Always
- flickering of the screen	(1)	2	3	4	5
- brightness of the screen	(1)	2	3	4	5
- contrast of the screen	(1)	2	3	4	5
- distance to the screen	(1)	2	3	4	5
- angle of the screen	(1)	2	3	4	5

For Official Use

	Never	Occas-ionally	Often	Very Often	Always
- the paper documents are not clearly legible	1	2	(3)	4	5
- the characters on the screen are not clearly recognisable	(1)	2	3	4	5
- glare on the screen	(1)	2	3	4	5
- the response time of the system after keying is not adequate	1	(2)	3	4	5
- the servicing is not adequate	1	2	(3)	4	5
- distance to the keyboard	(1)	2	3	4	5
- angle of the keyboard	(1)	2	3	4	5

11. This question asks you to indicate how much you agree or disagree with a number of general statements about how you view the use of the computer system.

Write a number in the blank beside each statement, based on the following scale.

1	2	3	4	5
Strongly disagree	Disagree with reservations	Do not agree or disagree	Agree with reservations	Strongly agree

4 The systems messages are easy to understand.

4 The replies given by the system are very "businesslike".

5 Using the system equires a lot of concentration.

4 The commands are all straight foreward to use.

2 I had considerable difficulty learning to use the system.

2 The system does not have a good "feel" to it.

4 I had no difficulty learning to use the system.

3 Some of the commands are rather obscure.

3 The system is very tiring to use.

2 The system is a real pleasure to use.

For Official Use

ALL RESPONDENTS PLEASE CONTINUE WITH SECTION 3

SECTION 3. PERSONAL WELL-BEING

The following questions ask about your general well-being over the last 6 months. As before please put a circle around the number representing your answer to each question.

1 Which of the following symptoms do you think you have suffered which you can relate to being at work:

	Never	Occas-ionally	Often	Very Often	Always
Eyestrain	(1)	2	3	4	5
Painful/Stiff neck or shoulders	1	2	3	(4)	5
Burning eyes	(1)	2	3	4	5
Sore shoulders	1	(2)	3	4	5
Back pain	1	2	3	(4)	5
Irritated eyes	(1)	2	3	4	5
Blurred vision	(1)	2	3	4	5
Painful/Stiff arms	(1)	2	3	4	5
Painful/Stiff legs	(1)	2	3	4	5
Neck pressure	1	2	3	(4)	5
Skin rash	(1)	2	3	4	5
Stomach pains	(1)	2	3	4	5
Swollen muscles or joints	1	(2)	3	4	5
Hand cramps	(1)	2	3	4	5
Stiff sore wrists	(1)	2	3	4	5
Change in colour perception	(1)	2	3	4	5
Fainting	(1)	2	3	4	5
Loss of feeling in fingers or wrists	(1)	2	3	4	5

For use of Researcher

2. The following statements are designed to find the degree to which you find certain aspects of your job stressful or a source of pressure. The word "pressure" should be interpreted in a wide sense eg worry, tension, anxiety, anger. Please circle the numbers underneath each statement which best reflects the way this aspect of your work makes you feel.

Code:	No Pressure at all	Some pressure	Moderate pressure	Strong Pressure	Extreme Pressure
	1	2	3	4	5

Difficulty in following through instructions in complex case.

No pressure 1 (2) 3 4 5 Extreme Pressure

Feeling that I cannot go "sick".

No pressure 1 (2) 3 4 5 Extreme Pressure

Not being consulted about changes that affect me.

No pressure 1 2 (3) 4 5 Extreme Pressure

Feeling that changes are not well planned.

No pressure 1 2 (3) 4 5 Extreme Pressure

Feeling that I am not well trained for my present post.

No pressure (1) 2 3 4 5 Extreme Pressure

Feeling that work statistics are meaningless.

No pressure (1) 2 3 4 5 Extreme Pressure

Feeling that I am not in touch with legislation changes.

No pressure 1 (2) 3 4 5 Extreme Pressure

Feeling that my work is becoming depersonalised.

No pressure 1 (2) 3 4 5 Extreme Pressure

Being unable to properly plan my workday.

No pressure 1 (2) 3 4 5 Extreme Pressure

For use of Researcher

Keeping up to date with departmental instructions.

No pressure (1) 2 3 4 5 Extreme Pressure

Petty office procedures and controls.

No pressure (1) 2 3 4 5 Extreme Pressure

The way work piles up on my desk when I take leave.

No pressure 1 (2) 3 4 5 Extreme Pressure

Work targets and deadlines.

No pressure (1) 2 3 4 5 Extreme Pressure

Having to "get rid" of work which I think is incomplete.

No pressure 1 (2) 3 4 5 Extreme Pressure

Feeling that I must "cut corners" in my work.

No pressure 1 (2) 3 4 5 Extreme Pressure

The technical difficulty of my work.

No pressure (1) 2 3 4 5 Extreme Pressure

The amount of work I am expected to do.

No pressure (1) 2 3 4 5 Extreme Pressure

For Official Use

3. Here are some items about how people may feel. When you think about yourself and your job over the past few weeks have you recently (circle the appropriate number):

	Never	A little of the time	Some of the time	A good part of the time	Most of the time
- been able to concentrate on whatever you're doing	1	2	3	4	(5)
- lost much sleep over worry	1	(2)	3	4	5
- felt that you are playing a useful part in things	1	2	3	(4)	5
- felt capable of making decisions about things	1	(2)	3	4	5
- felt constantly under strain	(1)	2	3	4	5
- felt you could not overcome your difficulties	(1)	2	3	4	5
- been able to enjoy your day to day activities	1	2	(3)	4	5
- been able to face up to your problems	1	2	3	4	(5)
- been feeling unhappy and depressed	1	(2)	3	4	5
- been losing confidence in yourself	1	(2)	3	4	5
- been thinking of yourself as a worthless person	1	(2)	3	4	5
- been feeling reasonably happy all things considered	1	2	3	(4)	5

For Official Use

SECTION 4

This part of the questionnaire asks you to describe your job, as objectively as you can. Please do not use this section to show how much you like or dislike your job. You will have the opportunity to do that in the next section.

Write a number in the blank beside each statement, based on the following scale:

1	2	3	4	5
Very Little	Little	Moderate Amount	Quite an amount	Very much

1 How much variety is there in your job?

4 How much are you left on your own to do your own work

2 To what extent are you able to decide how to do your job?

1 How often do you see projects or jobs through to completion?

2 To what extent do you find out how well you are doing on the job as you are working?

2 In general, how much influence do you have on how much you perform your job?

3 How much opportunity is there to meet individuals whom you would like to develop friendships with

3 How much of your job depends upon your ability to work with others?

1 In general, how much influence do you have on what goes on in your work group?

5 How repetitious are your duties?

2 To what extent are you able to act independently of your supervisor/line manager in performing you job functions?

1 In general, how much say or influence do you have on decisions which affect your job?

2 To what extent do you receive information from your superior on your job performance?

For Official Use

3 To what extent do you have the opportunity to talk informally with other employees while at work?

2 To what extent is dealing with other people a part of your job?

3 My superiors are receptive and listen to my ideas and suggstions?

5 How similar are the tasks you perform in a typical working day?

2 To what extent are you able to do your job independently of others?

For Official Use

Listed below are a number of characteristics which could be present on any job. People differ about how much they would like to have each one present in their own job. We are interested in learning how much you personally would like to have each one present in your job.

Using the scale below please indicate the degree to which you would like to have each characteristic present in your job.

As before write the appropriate number from the following scale against each statement:

1 2 3 4 5

A minimum amount	A slight amount	A moderate amount	Quite an amount	A maximum amount

5 The feedback from my supervisor/line manager on how well I'm doing.

4 Friendship from my colleagues.

3 The opportunity to talk to others on my job.

4 The opportunity to do a number of different things.

3 The freedom to do pretty much what I want to do on my job.

3 The degree to which the work I'm involved with is handled from beginning to end by myself.

5 The opportunity to find out how well I am doing on my job.

4 The opportunity in my job to get to know other people.

5 The amount of variety in my job.

4 The opportunity for independent thought and action

4 The opportunity to complete work I start.

5 The feeling that I know whether I am performing my job well or poorly.

3 The opportunity to develop close friendships in my job.

3 Meeting with others in my work.

3 The control I have over the pace of my work.

3 The opportunity to do a job from the beginning to end ie (the chance to do a whole job).

5 The extent of feedback you receive from individuals other than your supervisor/line manager.

For Official Use

SECTION 5

This part of the questionnaire deals with how much you like or dislike your job. Some jobs are more interesting and satisfying than others. We want to know how people feel about their jobs. For each of the following statements put a circle around one of the alternative answers which best describes your opinion. There are no right or wrong answers. It is YOUR opinion which matters.

Even though it may be hard to decide, be sure not to miss any questions out.

My job is like a hobby to me

Strongly Agree Agree Undecided Disagree Strongly Disagree

My job is usually interesting enough to keep me from getting bored

Strongly Agree Agree Undecided Disagree Strongly Disagree

It seems that my friends are more interested in their jobs

Strongly Agree Agree Undecided Disagree Strongly Disagree

I consider my job rather unpleasant

Strongly Agree Agree Undecided Disagree Strongly Disagree

I enjoy my work more than my leisure time

Strongly Agree Agree Undecided Disagree Strongly Disagree

I am often bored with my job

Strongly Agree Agree Undecided Disagree Strongly Disagree

I feel fairly well satisfied with my present job

Strongly Agree Agree Undecided Disagree Strongly Disagree

Most of the time I have to force myself to go to work

Strongly Agree Agree Undecided Disagree Strongly Disagree

THANK YOU

For Official Use

I am satisfied with my job for the time being

Strongly Agree Agree (Undecided) Disagree Strongly Disagree

I feel that my job is no more interesting than others I could get

Strongly Agree Agree Undecided (Disagree) Strongly Disagree

I definitely dislike my work

Strongly Agree Agree Undecided (Disagree) Strongly Disagree

I feel that I am happier in my work than most other people

Strongly Agree (Agree) Undecided Disagree Strongly Disagree

Most days I am enthusiastic about my work

Strongly Agree (Agree) Undecided Disagree Strongly Disagree

Each day of work seems like it will never end

Strongly Agree Agree Undecided (Disagree) Strongly Disagree

I like my job better that the average worker does

Strongly Agree (Agree) Undecided Disagree Strongly Disagree

My job is pretty uninteresting

Strongly Agree (Agree) Undecided Disagree Strongly Disagree

I find real enjoyment in my work

Strongly Agree Agree (Undecided) Disagree Strongly Disagree

I am disappointed that I ever took this job

Strongly Agree Agree Undecided (Disagree) Strongly Disagree

THANK YOU

Please check to be sure you have not missed any questions out.

APPENDIX 1b

QUESTIONNAIRE - SECTIONS 1 - 4

OFFICE WORK SURVEY

This survey is being used to examine the relationship between various elements of an office employee's job and the effects they have upon the individual.

Your assistance in completing the following questions as accurately as possible is very much appreciated, particularly ensuring that all the questions in Section 1 onwards are completed.

Your answers will be treated in complete confidence.

For Official Use
1, 2, 3, 4, 5,

Site [ ] Group [ ] Number [ ]

BACKGROUND INFORMATION

1 How long have you worked in
a. the Civil Service?
b. your present post?

a. [ ][ ]
b. [ ][ ]
Years Months

6, 7, 8, 9,
10, 11, 12, 13

2 How old are you? (Please circle a number 1-6)

Under 19	1
20 - 29	2
30 - 39	3
40 - 49	4
50 - 59	5
60 or Over	6

14

3 How would you describe the type of work you do? (Please circle a number)

Managerial	1
Professional/Specialist	2
Clerical	3
Secretarial	4
Other →	5

.....(Please specify)

15

4 What is your sex? (Please circle a number)

Female	1
Male	2

16

5 When in the office do you wear: (please circle a number)

	Yes	No	
Spectacles	1	2	17
Contact Lenses	1	2	18

6 What is your highest level of educational attainment? (Please circle a number)

None	1
CSE/'O' level	2
'A' level	3
Degree	4
Other	5

19

↓

.....(Please state)

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SECTION 1: ENVIRONMENTAL CONDITIONS

This section of the questionnaire asks you to consider how satisfactory you find your work area (that in which you spend the most time.)

1 How would you describe typical working conditions at your workplace in the office in WINTER? Write a number in the blank beside each statement based on the following scale.

1	2	3	4	5
Never	Occasionally	Often	Very Often	Always

it is too warm	____	20
it is comfortable	____	21
it is too cold	____	22
the temperature varies throughout the day	____	23
the temperature remains constant throughout the day	____	24
there is little air movement	____	25
there are uncomfortable draughts	____	26
the ventilation is satisfactory	____	27

2 How would you describe typical working conditions at your workplace in the SUMMER? (use the same scale)

it is too warm	____	28
it is comfortable	____	29
it is too cold	____	30
the temperature varies throughout the day	____	31
the temperature remains constant throughout the day	____	32
there is little air movement	____	33
there are uncomfortable draughts	____	34
the ventilation is satisfactory	____	35

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3 LIGHTING

1	2	3	4	5
Never	Occasionally	Often	Very Often	Always

At my workplace in the office I find that:

I have adequate daylight	——	36
I am bothered by reflections, glare or light flicker	——	37
the lighting is too bright for comfort	——	38
the lighting is satisfactory	——	39
the lighting is too dull	——	40

4 NOISE AND FURNITURE

At my workplace in the office I find that:

it is too quiet	——	41
I am distracted by noises in the office (talking, telephones)	——	42
I am annoyed by noise from office machines (typewriters, etc)	——	43
I am distracted from my work by outside noise	——	44
my desk is satisfactory	——	45
my chair is comfortable	——	46

SECTION 2. PERSONAL WELL-BEING

The following questions ask about your general well-being over the last 6 months. (Write a number in the blank beside each statement representing your answer).

1 Which of the following symptoms do you think you have suffered which you can relate to being at work:

1	2	3	4	5		For Official Use
Never	Occasionally	Often	Very Often	Always		
		Eyestrain			___	47
		Painful/Stiff neck or shoulders			___	48
		Burning eyes			___	49
		Sore shoulders			___	50
		Back pain			___	51
		Irritated eyes			___	52
		Blurred vision			___	53
		Painful/Stiff arms			___	54
		Painful/Stiff legs			___	55
		Neck pressure			___	56
		Skin rash			___	57
		Stomach pains			___	58
		Swollen muscles or joints			___	59
		Hand cramps			___	60
		Stiff sore wrists			___	61
		Change in colour perception			___	62
		Fainting			___	63
		Loss of feeling in fingers or wrists			___	64
		Headaches			___	65

For Official Use

2. Here are some items about how people may feel. When you think about yourself and your job over the past few weeks have you recently: (write a number in the blank beside each statement using the following scale)

1 2 3 4 5

Never	A little of the time	Some of the time	A good part of time	Always		
					been able to concentrate on what you're doing	66
					lost much sleep over worry	67
					felt that you are playing a useful part in things	68
					felt capable of making decisions about things	69
					felt constantly under strain	70
					felt you could not overcome your difficulties	71
					been able to enjoy your day to day activities	72
					been able to face up to your problems	73
					been feeling unhappy and depressed	74
					been losing confidence in yourself	75
					been thinking of yourself as a worthless person	76
					been feeling reasonably happy	77

For Official Use

SECTION 3

This part of the questionnaire asks you to describe your job, as objectively as you can. Please do not use this section to show how much you like or dislike your job. You will have the opportunity to do that in the next section.

Write a number in the blank beside each statement, based on the following scale:

1	2	3	4	5
Very Little	Little	Moderate Amount	Quite an amount	Very much

How much variety is there in your job? ___ 78

How much are you left on your own to do your own work? ___ 79

To what extent are you able to decide how to do your job? ___ 80

How often do you see projects or jobs through to completion? ___ 81

To what extent do you find out how well you are doing on the job as you are working? ___ 82

In general, how much influence do you have on how well you perform your job? ___ 83

How much opportunity is there to meet individuals whom you would like to develop friendships with? ___ 84

How much of your job depends upon your ability to work with others? ___ 85

In general, how much influence do you have on what goes on in your work group? ___ 86

How repetitious are your duties? ___ 87

To what extent are you able to act independently of your supervisor/line manager in performing you job functions? ___ 88

In general, how much say or influence do you have on decisions which affect your job? ___ 89

To what extent do you receive information from your superior on your job performance? ___ 90

		For Official Use
To what extent do you have the opportunity to talk informally with other employees while at work?	____	91
To what extent is dealing with other people a part of your job?	____	92
My superiors are receptive and listen to my ideas and suggstions?	____	93
How similar are the tasks you perform in a typical working day?	____	94
To what extent are you able to do your job independently of others?	____	95

For Official Use

Listed below are a number of characteristics which could be present on any job. People differ about how much they would like to have each one present in their own job. We are interested in learning how much you personally would like to have each one present in your job.

Using the scale below please indicate the degree to which you would like to have each characteristic present in your job.

As before write the appropriate number from the following scale against each statement:

1	2	3	4	5
A minimum amount	A slight amount	A moderate amount	Quite an amount	A maximum amount

The feedback from my supervisor/line manager on how well I'm doing. ____ 96

Friendship from my colleagues. ____ 97

The opportunity to talk to others on my job. ____ 98

The opportunity to do a number of different things. ____ 99

The freedom to do pretty much what I want to do on my job. ____ 100

The degree to which the work I'm involved with is handled from beginning to end by myself. ____ 101

The opportunity to find out how well I am doing on my job. ____ 102

The opportunity in my job to get to know other people. ____ 103

The amount of variety in my job. ____ 104

The opportunity for independent thought and action ____ 105

The opportunity to complete work I start. ____ 106

The feeling that I know whether I am performing my job well or poorly. ____ 107

The opportunity to develop close friendships in my job. ____ 108

Meeting with others in my work. ____ 109

The control I have over the pace of my work. ____ 110

The opportunity to do a job from the beginning to end i.e. (the chance to do a whole job). ____ 111

The extent of feedback you receive from individuals other than your supervisor/line manager. ____ 112

For Officia Use

SECTION 4

This part of the questionnaire deals with how much you like or dislike your job. Some jobs are more interesting and satisfying than others. We want to know how people feel about their jobs. There are no right or wrong answers. It is YOUR opinion which matters.

Even though it may be hard to decide, be sure not to miss any questions out. (As before use the appropriate number from the following scale against each statement).

1	2	3	4	5		
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree		
My job is like a hobby to me					____	113
My job is usually interesting enough to keep me from getting bored					____	114
It seems that my friends are more interested in their jobs					____	115
I consider my job rather unpleasant					____	116
I enjoy my work more than my leisure time					____	117
I am often bored with my job					____	118
I feel fairly well satisfied with my present job					____	119
Most of the time I have to force myself to go to work					____	120
I am satisfied with my job for the time being					____	121
I feel that my job is no more interesting than others I could get					____	122
I definitely dislike my work					____	123
I feel that I am happier in my work than most other people					____	124
Most days I am enthusiastic about my work					____	125
Each day of work seems like it will never end					____	126
I like my job better that the average worker does					____	127
My job is pretty uninteresting					____	128
I find real enjoyment in my work					____	129
I am disappointed that I ever took this job					____	130
I consider my job challenging					____	131

APPENDIX 1c

QUESTIONNAIRE - SECTION 5

For Official Use

SECTION 5

IF YOU WORK ON A VDU/WORD PROCESSOR PLEASE ANSWER THE FOLLOWING QUESTIONS.

1 How many hours on an average day do you normally work at a VDU? (State number of hours) ..... ____ 132

2 What is the maximum amount of time spent continuously working at a VDU without a break* (State number of hours) ____ 133

Note* A break means time both spent away from the VDU (and may include doing other work) as well as stopping for a rest period while at the VDU.

3 How many hours on an average day do you spend interacting with others (not including lunch time and only working hours)

(State number of hours) ..... ____ 134

4 How much time on an average day do you spend: (enter the number of hours in the box)

word processing		135
data input		136
programming		137
information retrieval		138
other (please specify)		139
.....		140-141
.....		

5 Whilst using my VDU I find the following problems bothersome: (as before indicate your answer by writing a number in the blank beside the statement using the following scale).

1 Never 2 Occasionally 3 Often 4 Very Often 5 Always

flickering of the screen	____	142
brightness of the screen	____	143
contrast of the screen	____	144
distance to the screen	____	145
angle of the screen	____	146

	For Official Use
the paper documents are not clearly legible ____	147
the characters on the screen are not clearly recognisable ____	148
glare on the screen ____	149
the response time of the system after keying is not adequate ____	150
the servicing is not adequate ____	151
distance to the keyboard ____	152
angle of the keyboard ____	153
breakdowns causing interruptions ____	154

6. This question asks you to indicate how much you agree or disagree with a number of general statements about how you view the use of the computer system.

Write a number in the blank beside each statement, based on the following scale.

1	2	3	4	5	
Strongly disagree	Disagree with reservations	Do not agree or disagree	Agree with reservations	Strongly agree	
The systems messages are easy to understand. ____					155
The replies given by the system are very "businesslike". ____					156
Using the system requires a lot of concentration. ____					157
The commands are all straight foreward to use. ____					158
I had considerable difficulty learning to use the system. ____					159
The system does not provide me with the correct help. ____					160
I had no difficulty learning to use the system. ____					161
Some of the commands are rather obscure. ____					162
The system is very tiring to use. ____					163
The system is a real assistance to my work. ____					164

7. Besides the VDU that you currently work with have you previously used a VDU or word processor? (please circle the appropriate numbers).

	Yes	No	
at school/college/university	1	2	165
at work	1	2	166
at home	1	2	167

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8. Do you have any additional comments to make about working with a VDU?

9. Do you have any suggestions that would improve working on VDU's?

THANK YOU YOUR VIEWS

Please check to be sure you have not missed any questions out.

APPENDIX 1d

OCAO ADDITIONAL QUESTIONNAIRE

VIENNA OFFICE IT SYSTEM

SECTION 1

1. What is your grade? .....

2. What is your section? .....

In questions 3 and 4 please tick the box that is closest to your views.

3. Do you use the Vienna system?

a.most of the time (it is a major part of your work) ____

b.frequently (most days) ____

c.occassionally (about twice a week) ____

d.infrequently (less than once a week) ____

e.not used at all ____

If infrequently or not at all why is this?

.....

.....

4. Is this amount of use:

a.more than you expected? ____

b.about what you had expected? ____

c.less than you expected? ____

SECTION 2.

Views on the Vienna system

This section concerns how you like aspects of the Vienna system. Please indicate your opinion by putting a circle round one of the numbers against it which corresponds to the following scale:-

1.like it a lot 2.like 3.neutral 4.dislike 5.dislike a lot

FOR EXAMPLE: If you consider that you like the screen a lot then circle 1 alongside that statement.

5.What is your overall opinion of the Vienna hardware?

	like it a lot				dislike a lot
a.VDU screen	1	2	3	4	5
b.Keyboard	1	2	3	4	5
c.Printers	1	2	3	4	5
d.Optical character reader	1	2	3	4	5
e.Plotter	1	2	3	4	5

6.What is your overall opinion of the Vienna software applications?

	like a lot				dislike a lot
a.Word processing	1	2	3	4	5
b.Electronic mail	1	2	3	4	5
c.Diary time management	1	2	3	4	5
d.Spreadsheet	1	2	3	4	5
e.Databases	1	2	3	4	5

SECTION 3

We would like to know how frequently you use the different applications of the Vienna system and how easy they are to use. Please indicate your opinion by putting a circle round one of the numbers against it which corresponds to the scale given.

6.How do you find the use of the different applications?

1.very easy 2.easy 3.in between 4.difficult 5.very difficult

	very easy				very difficult
a.Word processing	1	2	3	4	5
b.Electronic mail	1	2	3	4	5
c.Diary time management	1	2	3	4	5
d.Spreadsheet	1	2	3	4	5
e.Databases	1	2	3	4	5

7.How often do you use the individual applications? Please indicate your opinion by putting a circle round one of the numbers against it which corresponds to the scale given:-

1.every day 2.most days 3.about twice a week 4.less than once a week 5.do not use it

	every day				do not use it
a.Word processing	1	2	3	4	5
b.Electronic mail	1	2	3	4	5
c.Diary time management	1	2	3	4	5
d.Spreadsheet	1	2	3	4	5
e.Databases	1	2	3	4	5

8.Would you please provide the following details.

	Comments
Word processing	What type of work do you use it for?
Electronic mail	With whom do you communicate?
Diary Time Management	Which diaries do you access?
Spreadsheet	What type of work do you use it for?
Databases	What databases do you access?
Optical character reader	What material have you converted by using the OCR?
Plotter	What have you used this for?

SECTION 4

This section is seeking your views about the uses that could be developed for Vienna.

1.How well do you think Vienna is doing the things you expected it to do? (Please tick the appropriate box)

Very well	1
Fairly well	2
In between	3
Not particularly well	4
Not at all well	5
Do not know what it was expected to do	6

2. If not do you think this will improve with time/experience? (Please tick the appropriate box)

1	2	3
Yes	No	Don't know

If no, would you please explain why this is

.....

.....

.....

3.Could you give details of any tasks that you now use Vienna for that you did not anticipate.

.....

....

.....

4. Are you planning to increase the range of things you are using the system for?
(Please tick the appropriate box)

	1		2		3
Yes	☐	No	☐	Uncertain	☐

If yes, what proposals have you got?

.....

.....

.....

SECTION 5

This section is concerned with the training you received to use Vienna and the instruction manuals.

1. With the experience of using the system what are your views now on the training you were given? Please indicate your opinion by putting a circle round one of the numbers against it which corresponds to the scale given:-

1.very adequate 2.hardly adequate 3.neither adequate nor inadequate 4.inadequate 5.very inadequate

	very adequate				very inadequate
a.Word processing	1	2	3	4	5
b.Electronic mail	1	2	3	4	5
c.Diary time management	1	2	3	4	5
d.Spreadsheet	1	2	3	4	5
e.Databases	1	2	3	4	5

2.What changes would you have made to the training course?

.....

.....

....

3.Are there aspects of the system you would like training in or refresher training?

.....

.....

.....

4.What do you think of the user manual for the Vienna system?
(Please tick the appropriate box)

Too much detail	1
About the right amount of detail	2
Not enough detail	3

5.How often do you refer to the User Manual?
(Please tick the appropriate box)

Very frequently	1	Infrequently	4
Frequently	2	Not at all	5
Occassionally	3		

6.What particular topics in the User Manual do you have to look up?

.....

.....

.....

SECTION 6

1.The following are a list of benefits people thought Vienna would bring.To what extent have you experienced them? Please indicate your opinion by putting a circle round one of the numbers against it which corresponds to the scale given:-

1.To a large extent 2.To some extent 3.Uncertain 4.Not at all

	To a large extent			Not at all
Better use of my time	1	2	3	4
Do existing tasks quicker	1	2	3	4
Less retyping	1	2	3	4
Less proof reading	1	2	3	4
Improved drafting	1	2	3	4
Easier to retrieve information	1	2	3	4
Better decisions as more information is more readily available	1	2	3	4
Decrease amount of paperwork	1	2	3	4
Improve communication	1	2	3	4
Help me to plan my work better	1	2	3	4
Improved file control	1	2	3	4
More accurate costings	1	2	3	4
Speedier production of instructions	1	2	3	4
Better management information	1	2	3	4

2.The following are a list of worries people expressed about Vienna before the VDUs arrived. To what extent have you experienced them? Use the same scale as the last question and put a circle round the appropriate number:-

	To a large extent			Not at all
It will be a problem finding time to learn and do my normal job	1	2	3	4
Queueing to use a shared terminal	1	2	3	4
Not having a terminal in my room restricts the use of the system	1	2	3	4
It will take a long time to learn to use	1	2	3	4
While learning to use it my work will get into arrears	1	2	3	4
Electronic mail may not link the "right people"	1	2	3	4
It will be unreliable	1	2	3	4
Inadequate information on the way the system is developing	1	2	3	4
Inadequate support after training	1	2	3	4
The effort needed to convert existing records onto the computer	1	2	3	4

3.Have you experienced any other difficulties not listed above?.....

.....

.....

4.Are there any improvements you would like made to the Vienna system?.....

.....

.....

PLEASE CHECK THAT YOU HAVE ANSWERED ALL THE QUESTIONS.THANK YOU FOR COMPLETING THE QUESTIONNAIRE.

APPENDIX 2

EXAMPLE OF LETTERS ACCOMPANYING QUESTIONNAIRES

CABINET OFFICE
to the MINISTER
for CIVIL SERVICE

JOB SATISFACTION TEAM
GOVERNMENT OFFICES
Horse Guards Road
London SW1P 3AL
Telephone: 01-270 6274

June 1988

Dear Colleague

OFFICE WORK SURVEY

A number of you will remember completing a questionnaire asking about your views on aspects of your work and workplace. The questionnaire was issued as part of a study being undertaken by a member of the Job Satisfaction Team (a part of the Cabinet office) in co-operation with Aston University into the effect of the introduction of computer systems.

Many of you kindly completed a form. In order to make comparisons with the information gained in the earlier questionnaires I would be grateful if you would complete the attached questionnaire. For those of you who completed the first questionnaire you will see that the first four sections are the same as before. The fifth section asks questions about your work with the computer terminals. If you completed a questionnaire in November 1986 please put a cross at the top right hand corner of the front page of this questionnaire. I would be grateful if you would complete all parts of the form.

Your managers and trade union representatives have agreed to the questionnaires being completed. Whilst your managers have agreed to make time available during working hours to complete the questionnaire, participation is voluntary and you can decide not to complete the questionnaire.

Steps have been taken to assure you of complete confidentiality - please do not put your name anywhere on the questionnaire. Your answers will be combined with others so that no individual answers will be reported to anybody. The questionnaire is numbered for those who completed a form earlier. Would you return the completed questionnaire to me direct in the envelope provided. Thank you for your co-operation in this study.

David Shaw.

DAVID SHAW

Dear Colleague

VIENNA OFFICE IT SYSTEM

As part of the evaluation of the Vienna office support system the evaluation team would like to find out the views of the staff about their workplace and their jobs and personal well-being.

Your managers have agreed to make time available during working hours to complete the questionnaire. Your participation is, voluntary and you can decide not to complete it. However, the greater the number of participants the more representative the results will be and I hope you will feel able to assist in the study.

Steps have been taken to assure you of complete confidentiality. The evaluation team is being assisted in the analysis of the results by a member of the Job Satisfaction team of the Management and Personnel Office (a part of the Cabinet Office), who will receive the questionnaire direct from you without your line managers seeing your views. Individual views will be combined with others so that no individual answers will be reported to anybody; it is important that you do not put your name anywhere on the questionnaire.

Please complete the questionnaire as soon as possible. It will take about 20-25 minutes to complete. The analysis of the results would be assisted if you could post the completed questionnaire in the pre-paid envelope provided within 7 days.

Thank you for taking time to give your views and in due course the evaluation team will feed the results back to you.

Yours sincerely

Evaluation Team.

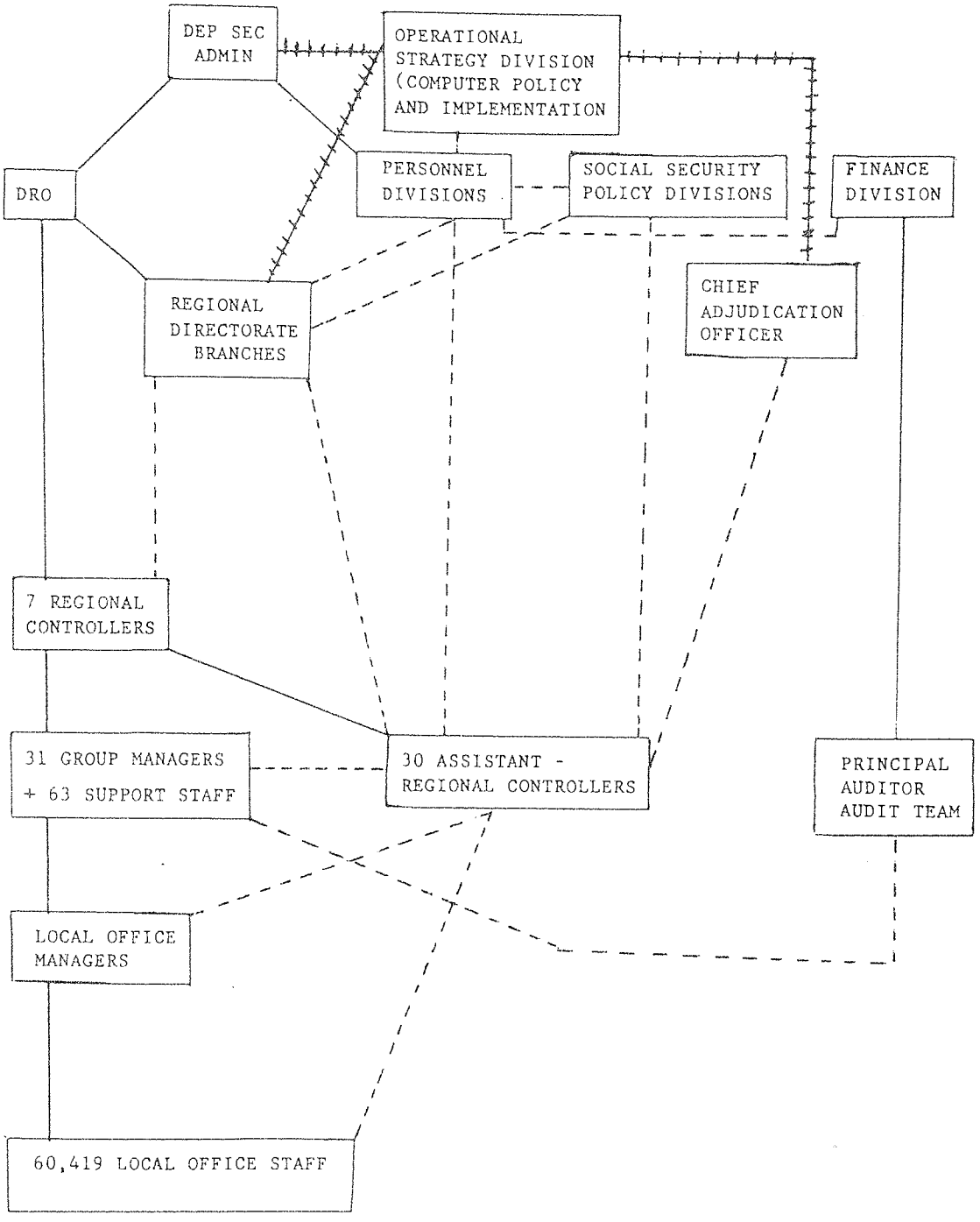
APPENDIX 3

DHSS ORGANISATION CHART

HEADQUARTERS

REGIONAL OFFICES

LOCAL OFFICES



Staff relationship: - - - - - - - - - - - -

Line relationship: ————————————

Office Systems Support ++++++++++++++++++++++++++

APPENDIX 4

ERGONOMICS QUESTIONNAIRE

THE DESIGN AND OPERATING CHARACTERISTICS OF VDTs

ERGONOMICS CHECKLIST

CHILD BENEFIT CENTRE.

THE DISPLAY SCREEN

CHARACTER FORMATION

		YES	NO
1.	Does the screen have a display capacity, ie a number of available character spaces, that is sufficient for the task?	✓	
2.	Is the display memory accessed by		
	roll scrolling?		
	page scrolling?	✓	
	pan scrolling?		
3.	Is scrolling under keyboard control?	✓	
4.	Is the character set sufficient for the task?	✓	
5.	Is the colour of the characters in the display		
	white?		
	yellow?		
	green?	✓	
	other?		
6.	Is the character height greater than or equal to 3 mm?	✓	
7.	If the characters are generated by dot matrix, does the individual dots merge sufficiently well so as to produce a sharp and well defined image?	✓	

	YES	NO
8. Is it possible to clearly distinguish between the following characters?		✓
X and K?	✓	
O and Q?	✓	
T and Y?	✓	
S and 5?	✓	
I and L?	✓	
U and V?	✓	
I and 1?	✓	
9. Is it possible to clearly distinguish between the number "0" and the letter "O" (it should be noted that the letter Ø is included in several Nordic alphabets and should not be used to represent the number "0")?	✓	
10. Are the basic characters upright, ie not slanted?	✓	
11. Is it possible to adjust the orientation of the screen of the VDT about its vertical axis?	✓	
12. Is it possible to adjust the screen about its horizontal axis? (screen angle)	✓	
CODING, FORMAT		
13. Is luminance, ie selective brightening used as a means of coding in the display?	✓	
14. Is it possible to clearly distinguish between the different luminance levels at maximum setting?	✓	
15. Is a cursor provided?	✓	
16. Is it possible to clearly distinguish the cursor from other symbols on the display?	✓	

	YES	NO
17. Is it possible to suppress the repeated blink action of the cursor?	___	✓

THE DISPLAY SCREEN AND LUMINANCE

18. Is the character luminance adjustable?	✓	___
19. Are the displayed character images stable?	✓	___

THE KEYBOARD

GENERAL CRITERIA

1. Is the keyboard detached from the display screen console, ie joined by a cable?	✓	___
2. Is the weight of the keyboard sufficient to ensure stability against unintentional movement?	✓	___
3. Is the thickness of the keyboard, ie base to the home row of keys		
less than 50 mm? (acceptable)	✓	___
30 mm? (preferred)	___	___
4. Is the profile of the keyboard		
stepped?	___	___
sloped?	___	___
dished?	✓	___
5. Is the angle of the keyboard in the range 5-15°?	___	✓
6. Is the surface of the keyboard surround matt finished?	✓	___
7. Is there at least a 50 mm deep space provided for resting the palms of the hands?	✓	___

KEY CHARACTERISTICS

	YES	NO
8. Is the key travel between 0.8 and 4.8 mm?	✓	
9. For square keytops is the keytop size between ☒ 12 and ☒ 15 mm?	✓	
10. Is the centre spacing between adjacent keys between 18 and 20 mm?	✓	
11. Are the key legends resistant to wear and abrasion, ie are the legends moulded into the keytop?	✓	
12. Are the keytop surfaces concave so as to improve keyboarding accuracy?	✓	
13. Are the keytop surfaces such that specular reflections are kept to a minimum?	✓	
14. Is the activation of each key accompanied by a feedback signal such as an		
audible click?	✓	
tactile click?		
or snap action?		
15. Do the keys have a low failure rate?	✓	
16. If two keys are activated simultaneously, is a warning signal given?	✓	

KEYBOARD LAYOUT

17. Does the layout of the alpha keys correspond to the conventional typewriter keyboard layout?	✓	
18. Does the layout of the numeric keys - above the alpha keys - correspond to the conventional typewriter keyboard layout?	✓	

	YES	NO
19. Are the numeric keys grouped in a separate block:		
as the only numeric keyset?	—	—
or as an auxiliary keyset in addition to the keyset referred to under 2?	✓	—
20. Is the space bar at the bottom of the keyboard?	✓	—
21. Are the different function key blocks distinct from the other keys by		
colour?	—	—
shape?	—	—
position?	✓	—
distance (spacing)?	—	—

WORKSTATION DESIGN (Worksurfaces, Partitions and Footrests)

1. Is there a sufficient area of work surface for the potential range of activities intended at the workstation?	✓	—
2. Is there sufficient room on the worksurface to accommodate the necessary range of equipment plus the necessary peripherals (eg paper for the printer)?	✓	—
3. Is the desk surface height suitable for a good writing posture, ie between 720 mm and 750 mm?	✓	—
4. Is a separate portable footrest provided for shorter people to use?	✓	—
5. Is the depth of the desk between 650 mm and 750 mm or deeper if the size of the equipment requires it?	✓	—
6. Is the space available for the legs sufficient in height and depth for comfort (including changes of posture)? Recommendations are 690 mm min. for height, 700 mm min, for depth.	✓	—

	YES	NO
7. Is the leg area at least 800 mm wide to permit unobstructed turning?	✓	
8. Is there a document holder available?		✓

CHAIR

	YES	NO
1. Is the height easily adjustable?	✓	
2. Is the chair base stable (five-point)?	✓	
3. Is the height of the backrest adjustable?	✓	
4. Can adjustments be easily and safely made from the seated position?	✓	
5. Is the front edge of the seat rounded to avoid cutting into thighs?	✓	
6. Can the backrest be adjusted forwards and backwards?	✓	
7. Is the seat surface padded with an absorbent material which will be comfortable in use?	✓	
8. Is there guidance available to individuals to help them achieve optimum adjustment of their chairs?	✓	

THE DESIGN AND OPERATING CHARACTERISTICS OF VDTs

ERGONOMICS CHECKLIST

PENSIONS BRANCH, OVERSEAS GROUP.

THE DISPLAY SCREEN

CHARACTER FORMATION

	YES	NO
1. Does the screen have a display capacity, ie a number of available character spaces, that is sufficient for the task?	✓	
2. Is the display memory accessed by		
roll scrolling?		
page scrolling?	✓	
pan scrolling?		
3. Is scrolling under keyboard control?	✓	
4. Is the character set sufficient for the task?	✓	
5. Is the colour of the characters in the display		
white?		
yellow?		
green?	✓	
other?		
6. Is the character height greater than or equal to 3 mm?	✓	
7. If the characters are generated by dot matrix, does the individual dots merge sufficiently well so as to produce a sharp and well defined image?	✓	

		YES	NO
8.	Is it possible to clearly distinguish between the following characters?		
	X and K?	✓	
	O and Q?	✓	
	T and Y?	✓	
	S and 5?	✓	
	I and L?	✓	
	U and V?	✓	
	I and 1?	✓	
9.	Is it possible to clearly distinguish between the number "0" and the letter "O" (it should be noted that the letter Ø is included in several Nordic alphabets and should not be used to represent the number "0")?	✓	
10.	Are the basic characters upright, ie not slanted?	✓	
11.	Is it possible to adjust the orientation of the screen of the VDT about its vertical axis?	✓	
12.	Is it possible to adjust the screen about its horizontal axis? (screen angle)	✓	

CODING, FORMAT

13.	Is luminance, ie selective brightening used as a means of coding in the display?	✓	
14.	Is it possible to clearly distinguish between the different luminance levels at maximum setting?	✓	
15.	Is a cursor provided?	✓	
16.	Is it possible to clearly distinguish the cursor from other symbols on the display?	✓	

	YES	NO
17. Is it possible to suppress the repeated blink action of the cursor?		✓

THE DISPLAY SCREEN AND LUMINANCE

18. Is the character luminance adjustable?	✓	
19. Are the displayed character images stable?	✓	

THE KEYBOARD

GENERAL CRITERIA

1. Is the keyboard detached from the display screen console, ie joined by a cable?	✓	
2. Is the weight of the keyboard sufficient to ensure stability against unintentional movement?	✓	
3. Is the thickness of the keyboard, ie base to the home row of keys		
less than 50 mm? (acceptable)		
30 mm? (preferred)	✓	
4. Is the profile of the keyboard		
stepped?		
sloped?	✓	
dished?		
5. Is the angle of the keyboard in the range 5-15°?	✓	
6. Is the surface of the keyboard surround matt finished?	✓	
7. Is there at least a 50 mm deep space provided for resting the palms of the hands?		✓

KEY CHARACTERISTICS

		YES	NO
8.	Is the key travel between 0.8 and 4.8 mm?	✓	
9.	For square keytops is the keytop size between ☒ 12 and ☒ 15 mm?	✓	
10.	Is the centre spacing between adjacent keys between 18 and 20 mm?	✓	
11.	Are the key legends resistant to wear and abrasion, ie are the legends moulded into the keytop?	✓	
12.	Are the keytop surfaces concave so as to improve keyboarding accuracy?	✓	
13.	Are the keytop surfaces such that specular reflections are kept to a minimum?	✓	
14.	Is the activation of each key accompanied by a feedback signal such as an		
	audible click?		✓
	tactile click?		✓
	or snap action?		✓
15.	Do the keys have a low failure rate?	✓	
16.	If two keys are activated simultaneously, is a warning signal given?		✓

KEYBOARD LAYOUT

17.	Does the layout of the alpha keys correspond to the conventional typewriter keyboard layout?		
18.	Does the layout of the numeric keys - above the alpha keys - correspond to the conventional typewriter keyboard layout?		

	YES	NO
19. Are the numeric keys grouped in a separate block:		
as the only numeric keyset?	—	—
or as an auxiliary keyset in addition to the keyset referred to under 2?	✓	—
20. Is the space bar at the bottom of the keyboard?	✓	—
21. Are the different function key blocks distinct from the other keys by		
colour?	✓	—
shape?	—	—
position?	✓	—
distance (spacing)?	—	—

WORKSTATION DESIGN (Worksurfaces, Partitions and Footrests)

1. Is there a sufficient area of work surface for the potential range of activities intended at the workstation?	✓	—
2. Is there sufficient room on the worksurface to accommodate the necessary range of equipment plus the necessary peripherals (eg paper for the printer)?	✓	—
3. Is the desk surface height suitable for a good writing posture, ie between 720 mm and 750 mm?	✓	—
4. Is a separate portable footrest provided for shorter people to use?	—	✓
5. Is the depth of the desk between 650 mm and 750 mm or deeper if the size of the equipment requires it?	✓	—
6. Is the space available for the legs sufficient in height and depth for comfort (including changes of posture)? Recommendations are 690 mm min. for height, 700 mm min, for depth.	✓	—

	YES	NO
7. Is the leg area at least 800 mm wide to permit unobstructed turning?	✓	
8. Is there a document holder available?	✓	

CHAIR

1. Is the height easily adjustable?	✓	
2. Is the chair base stable (five-point)?	✓	
3. Is the height of the backrest adjustable?	✓	
4. Can adjustments be easily and safely made from the seated position?	✓	
5. Is the front edge of the seat rounded to avoid cutting into thighs?	✓	
6. Can the backrest be adjusted forwards and backwards?	✓	
7. Is the seat surface padded with an absorbent material which will be comfortable in use?	✓	
8. Is there guidance available to individuals to help them achieve optimum adjustment of their chairs?	✓	

THE DESIGN AND OPERATING CHARACTERISTICS OF VDTs

ERGONOMICS CHECKLIST

THE OFFICE OF THE CHIEF ADJUDICATION OFFICER.

THE DISPLAY SCREEN

CHARACTER FORMATION

		YES	NO
1.	Does the screen have a display capacity, ie a number of available character spaces, that is sufficient for the task?	✓	
2.	Is the display memory accessed by		
	roll scrolling?		
	page scrolling?		
	pan scrolling?	✓	
3.	Is scrolling under keyboard control?	✓	
4.	Is the character set sufficient for the task?		✓ ¼ ½ ÷ missing
5.	Is the colour of the characters in the display		
	white?		
	yellow?		
	green?		
	other? Black on white.	✓	
6.	Is the character height greater than or equal to 3 mm?	✓	
7.	If the characters are generated by dot matrix, does the individual dots merge sufficiently well so as to produce a sharp and well defined image?	✓	

	YES	NO
8. Is it possible to clearly distinguish between the following characters?		
X and K?	✓	
O and Q?	✓	
T and Y?	✓	
S and 5?	✓	
I and L?	✓	
U and V?	✓	
I and 1?	✓	
9. Is it possible to clearly distinguish between the number "0" and the letter "O" (it should be noted that the letter Ø is included in several Nordic alphabets and should not be used to represent the number "0")?	✓	
10. Are the basic characters upright, ie not slanted?	✓	
11. Is it possible to adjust the orientation of the screen of the VDT about its vertical axis?	✓	
12. Is it possible to adjust the screen about its horizontal axis? (screen angle)	✓	
CODING, FORMAT		
13. Is luminance, ie selective brightening used as a means of coding in the display?	✓	
14. Is it possible to clearly distinguish between the different luminance levels at maximum setting?	✓	
15. Is a cursor provided?	✓	
16. Is it possible to clearly distinguish the cursor from other symbols on the display?	✓	

	YES	NO
17. Is it possible to suppress the repeated blink action of the cursor?		✓

THE DISPLAY SCREEN AND LUMINANCE

18. Is the character luminance adjustable?	✓	
19. Are the displayed character images stable?	✓	

THE KEYBOARD

GENERAL CRITERIA

1. Is the keyboard detached from the display screen console, ie joined by a cable?	✓	
2. Is the weight of the keyboard sufficient to ensure stability against unintentional movement?	✓	
3. Is the thickness of the keyboard, ie base to the home row of keys		
less than 50 mm? (acceptable)		
30 mm? (preferred)	✓	
4. Is the profile of the keyboard		
stepped?		
sloped?	✓	
dished?		
5. Is the angle of the keyboard in the range 5-15°?	✓	
6. Is the surface of the keyboard surround matt finished?	✓	
7. Is there at least a 50 mm deep space provided for resting the palms of the hands?		✓

KEY CHARACTERISTICS

	YES	NO
8. Is the key travel between 0.8 and 4.8 mm?	✓	—
9. For square keytops is the keytop size between ☒ 12 and ☒ 15 mm?	—	✓ 18mm
10. Is the centre spacing between adjacent keys between 18 and 20 mm?	✓	—
11. Are the key legends resistant to wear and abrasion, ie are the legends moulded into the keytop?	—	✓
12. Are the keytop surfaces concave so as to improve keyboarding accuracy?	✓	—
13. Are the keytop surfaces such that specular reflections are kept to a minimum?	✓	—
14. Is the activation of each key accompanied by a feedback signal such as an		
audible click?	✓	—
tactile click?	—	—
or snap action?	—	—
15. Do the keys have a low failure rate?	✓	—
16. If two keys are activated simultaneously, is a warning signal given?	✓	—

KEYBOARD LAYOUT

17. Does the layout of the alpha keys correspond to the conventional typewriter keyboard layout?	✓	—
18. Does the layout of the numeric keys - above the alpha keys - correspond to the conventional typewriter keyboard layout?	✓	—

	YES	NO
19. Are the numeric keys grouped in a separate block:		
as the only numeric keyset?	—	—
or as an auxiliary keyset in addition to the keyset referred to under 2?	✓	—
20. Is the space bar at the bottom of the keyboard?	✓	—
21. Are the different function key blocks distinct from the other keys by		
colour?	✓	—
shape?	✓	—
position?	✓	—
distance (spacing)?	—	—

WORKSTATION DESIGN (Worksurfaces, Partitions and Footrests)

1. Is there a sufficient area of work surface for the potential range of activities intended at the workstation?	✓	—
2. Is there sufficient room on the worksurface to accommodate the necessary range of equipment plus the necessary peripherals (eg paper for the printer)?	✓	—
3. Is the desk surface height suitable for a good writing posture, ie between 720 mm and 750 mm?	✓	—
4. Is a separate portable footrest provided for shorter people to use?	—	✓
5. Is the depth of the desk between 650 mm and 750 mm or deeper if the size of the equipment requires it?	✓	—
6. Is the space available for the legs sufficient in height and depth for comfort (including changes of posture)? Recommendations are 690 mm min. for height, 700 mm min, for depth.	✓	—

	YES	NO
7. Is the leg area at least 800 mm wide to permit unobstructed turning?		✓
8. Is there a document holder available?	✓	

CHAIR

1. Is the height easily adjustable?	✓	
2. Is the chair base stable (five-point)?	✓	
3. Is the height of the backrest adjustable?	✓	
4. Can adjustments be easily and safely made from the seated position?	✓	
5. Is the front edge of the seat rounded to avoid cutting into thighs?	✓	
6. Can the backrest be adjusted forwards and backwards?	✓	
7. Is the seat surface padded with an absorbent material which will be comfortable in use?	✓	
8. Is there guidance available to individuals to help them achieve optimum adjustment of their chairs?	✓	

THE DESIGN AND OPERATING CHARACTERISTICS OF VDTs

ERGONOMICS CHECKLIST

REGIONAL DIRECTORATE HEADQUARTERS.

THE DISPLAY SCREEN

CHARACTER FORMATION

	YES	NO
1. Does the screen have a display capacity, ie a number of available character spaces, that is sufficient for the task?	✓	
2. Is the display memory accessed by		
roll scrolling?	✓	
page scrolling?		
pan scrolling?		
3. Is scrolling under keyboard control?	✓	
4. Is the character set sufficient for the task?	✓	
5. Is the colour of the characters in the display		
white?		
yellow?	✓	
green?		
other?		
6. Is the character height greater than or equal to 3 mm?	✓	
7. If the characters are generated by dot matrix, does the individual dots merge sufficiently well so as to produce a sharp and well defined image?	✓	

	YES	NO
8. Is it possible to clearly distinguish between the following characters?		
X and K?	✓	
O and Q?	✓	
T and Y?	✓	
S and 5?	✓	
I and L?	✓	
U and V?	✓	
I and 1?	✓	
9. Is it possible to clearly distinguish between the number "0" and the letter "O" (it should be noted that the letter Ø is included in several Nordic alphabets and should not be used to represent the number "0")?	✓	
10. Are the basic characters upright, ie not slanted?	✓	
11. Is it possible to adjust the orientation of the screen of the VDT about its vertical axis?	✓	
12. Is it possible to adjust the screen about its horizontal axis? (screen angle)	✓	
CODING, FORMAT		
13. Is luminance, ie selective brightening used as a means of coding in the display?	✓	
14. Is it possible to clearly distinguish between the different luminance levels at maximum setting?	✓	
15. Is a cursor provided?	✓	
16. Is it possible to clearly distinguish the cursor from other symbols on the display?	✓	

	YES	NO
17. Is it possible to suppress the repeated blink action of the cursor?	—	✓

THE DISPLAY SCREEN AND LUMINANCE

18. Is the character luminance adjustable?	✓	—
19. Are the displayed character images stable?	✓	—

THE KEYBOARD

GENERAL CRITERIA

1. Is the keyboard detached from the display screen console, ie joined by a cable?	✓	—
2. Is the weight of the keyboard sufficient to ensure stability against unintentional movement?	✓	—
3. Is the thickness of the keyboard, ie base to the home row of keys		
less than 50 mm? (acceptable)	✓	—
30 mm? (preferred)	—	—
4. Is the profile of the keyboard		
stepped?	—	—
sloped?	✓	—
dished?	—	—
5. Is the angle of the keyboard in the range 5-15°?	✓	—
6. Is the surface of the keyboard surround matt finished?	✓	—
7. Is there at least a 50 mm deep space provided for resting the palms of the hands?	—	✓

KEY CHARACTERISTICS

	YES	NO
8. Is the key travel between 0.8 and 4.8 mm?	✓	
9. For square keytops is the keytop size between ☒ 12 and ☒ 15 mm?	✓	
10. Is the centre spacing between adjacent keys between 18 and 20 mm?	✓	
11. Are the key legends resistant to wear and abrasion, ie are the legends moulded into the keytop?	✓	
12. Are the keytop surfaces concave so as to improve keyboarding accuracy?	✓	
13. Are the keytop surfaces such that specular reflections are kept to a minimum?	✓	
14. Is the activation of each key accompanied by a feedback signal such as an		
audible click?	✓	
tactile click?		
or snap action?		
15. Do the keys have a low failure rate?	✓	
16. If two keys are activated simultaneously, is a warning signal given?	✓	

KEYBOARD LAYOUT

17. Does the layout of the alpha keys correspond to the conventional typewriter keyboard layout?	✓	
18. Does the layout of the numeric keys - above the alpha keys - correspond to the conventional typewriter keyboard layout?	✓	

	YES	NO
19. Are the numeric keys grouped in a separate block:		
as the only numeric keyset?	—	—
or as an auxiliary keyset in addition to the keyset referred to under 2?	✓	—
20. Is the space bar at the bottom of the keyboard?	✓	—
21. Are the different function key blocks distinct from the other keys by		
colour?	✓	—
shape?	—	—
position?	✓	—
distance (spacing)?	—	—

WORKSTATION DESIGN (Worksurfaces, Partitions and Footrests)

1. Is there a sufficient area of work surface for the potential range of activities intended at the workstation?	✓	—
2. Is there sufficient room on the worksurface to accommodate the necessary range of equipment plus the necessary peripherals (eg paper for the printer)?	✓	—
3. Is the desk surface height suitable for a good writing posture, ie between 720 mm and 750 mm?	✓	—
4. Is a separate portable footrest provided for shorter people to use?	—	✓
5. Is the depth of the desk between 650 mm and 750 mm or deeper if the size of the equipment requires it?	—	✓
6. Is the space available for the legs sufficient in height and depth for comfort (including changes of posture)? Recommendations are 690 mm min. for height, 700 mm min, for depth.	✓ HEIGHT	✓ DEPTH

		YES	NO
7.	Is the leg area at least 800 mm wide to permit unobstructed turning?	—	✓
8.	Is there a document holder available?	—	✓

CHAIR

1.	Is the height easily adjustable?	✓	—
2.	Is the chair base stable (five-point)?	✓	—
3.	Is the height of the backrest adjustable?	✓	—
4.	Can adjustments be easily and safely made from the seated position?	✓	—
5.	Is the front edge of the seat rounded to avoid cutting into thighs?	✓	—
6.	Can the backrest be adjusted forwards and backwards?	✓	—
7.	Is the seat surface padded with an absorbent material which will be comfortable in use?	✓	—
8.	Is there guidance available to individuals to help them achieve optimum adjustment of their chairs?	✓	—

APPENDIX 5

DIAGRAMS OF THE INTERACTIVE MODEL FOR THE OFFICE WORKERS RESPONSES

Diagram 14.1

Interactive Model for Office Worker's Responses:
the Pre-implementation path coefficients for the ILLNESS factors.

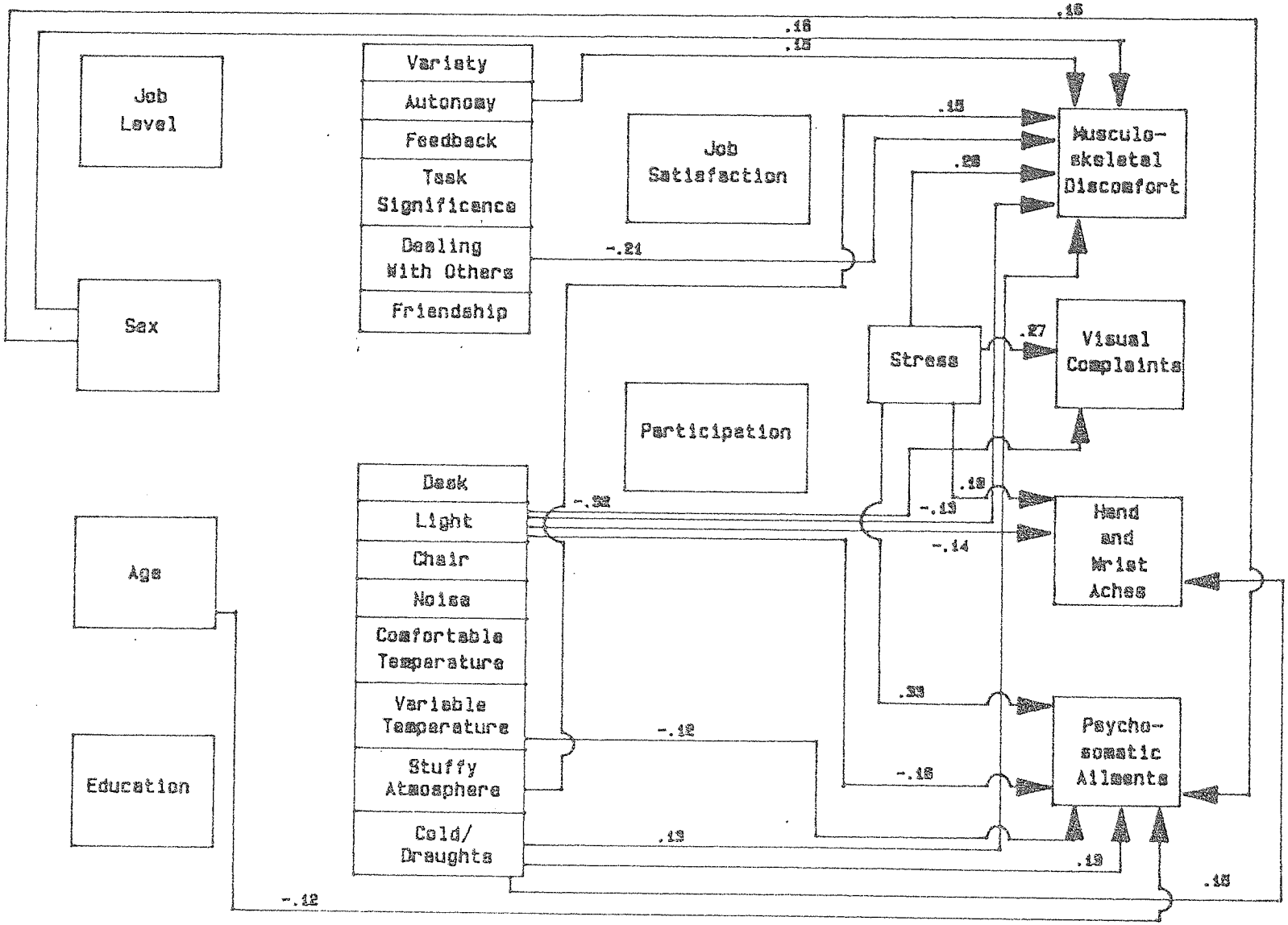


Diagram 14.2

Interactive Model for Office Worker's Responses:
the Pre-implementation path coefficients for the affective variables

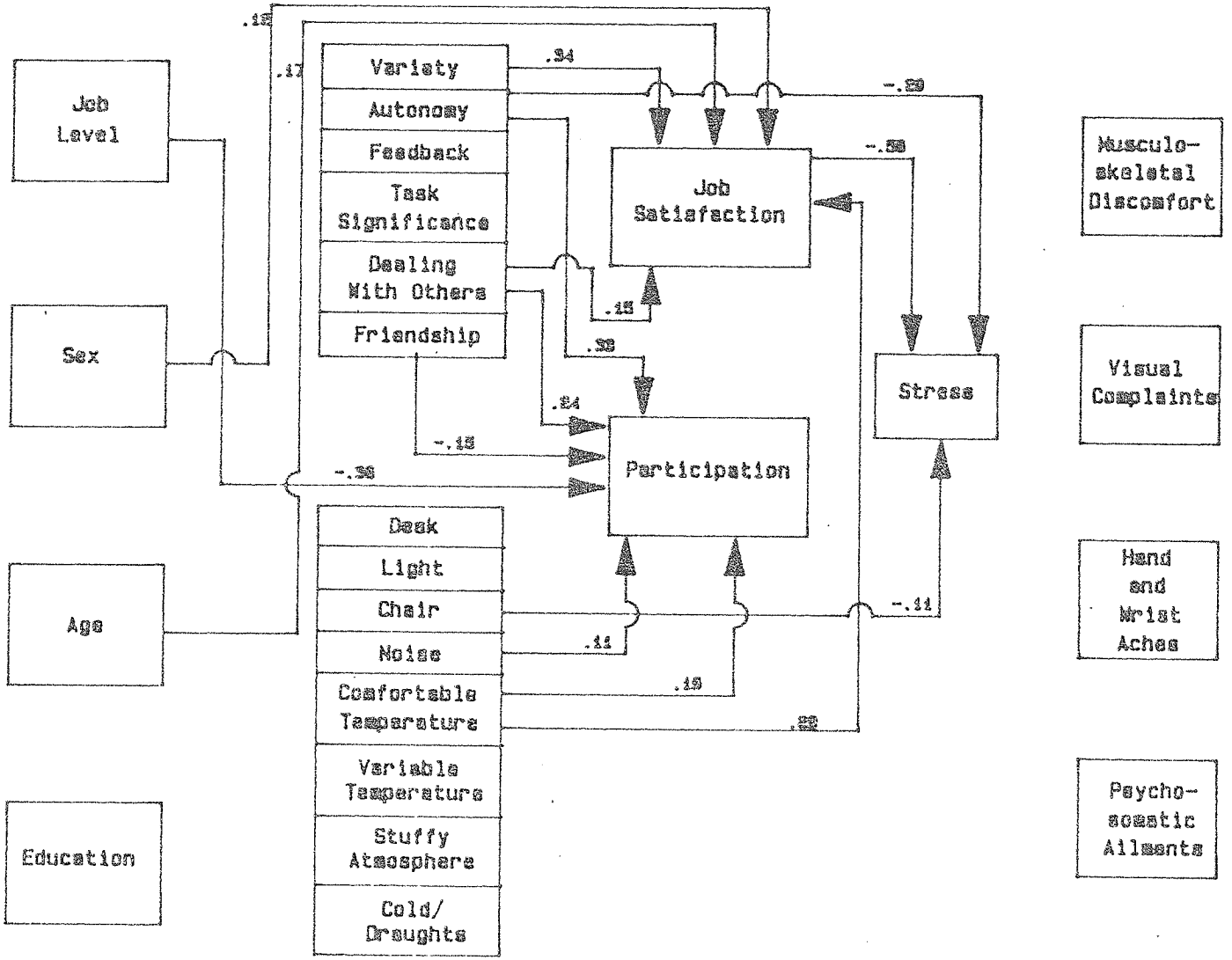


Diagram 14.3

Interactive Model for Office Worker's Responses:
the Pre-implementation demographic variable's path coefficients
to the office environment and job characteristic variables.

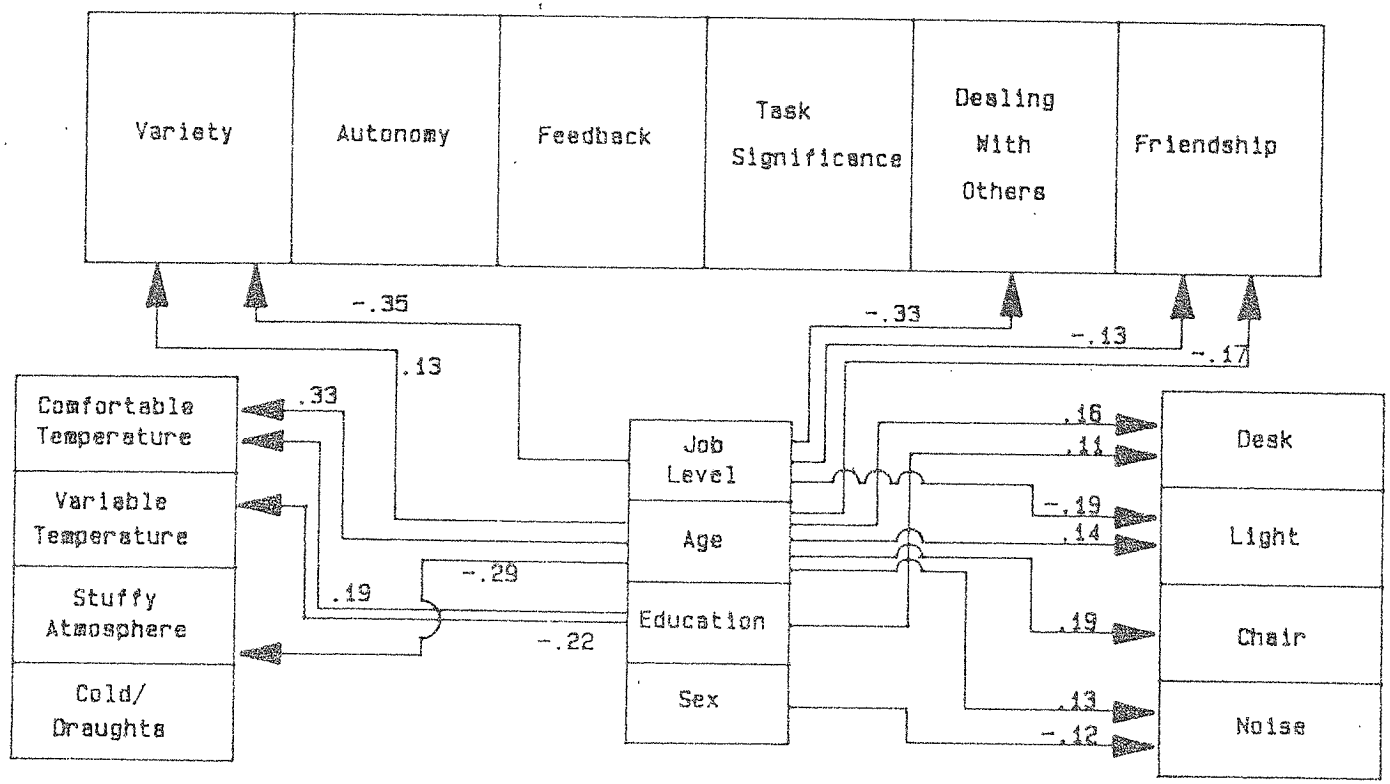


Diagram 14.4 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the four sites for the ILLNESS factors

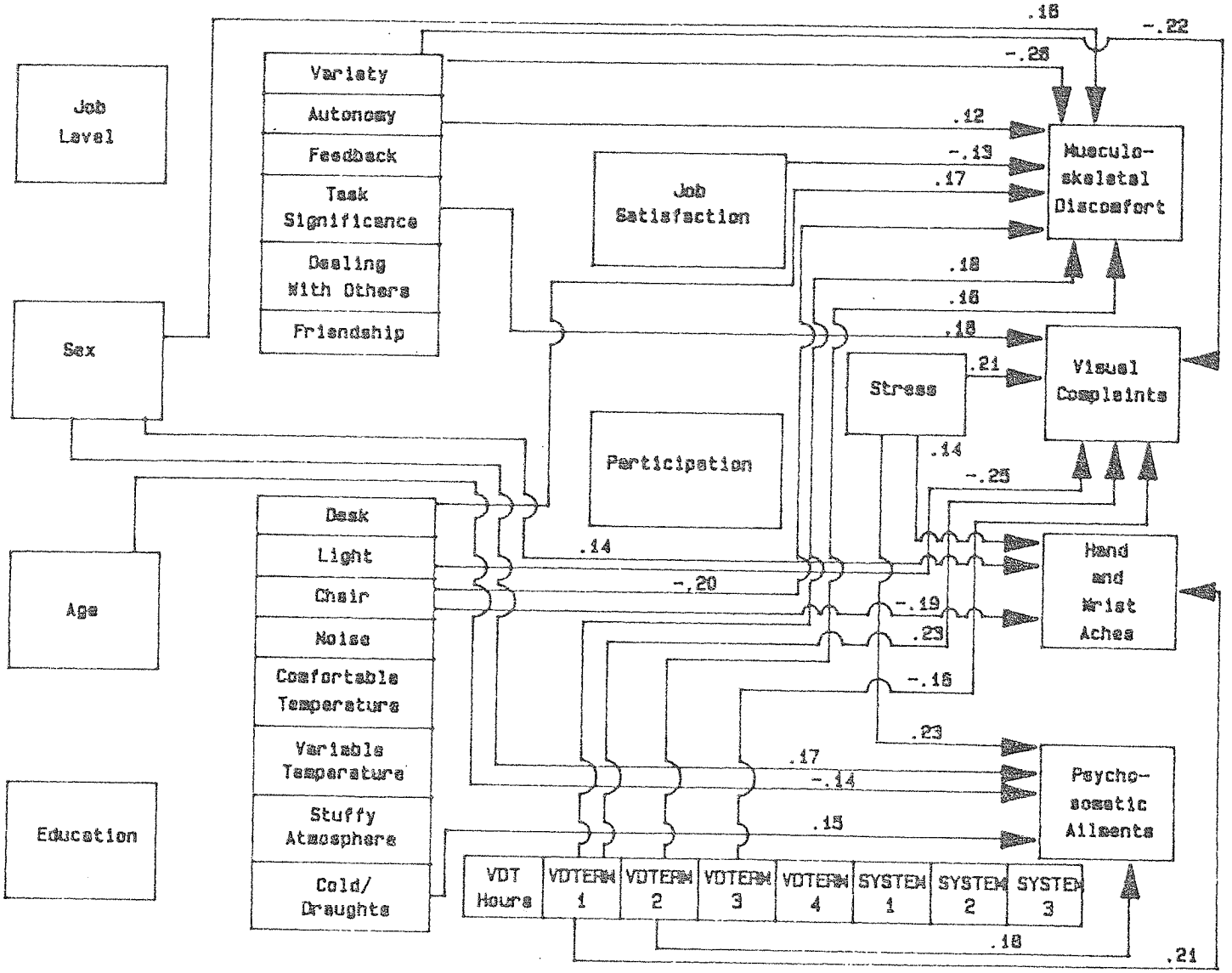


Diagram 14.5 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the four sites for the affective variables

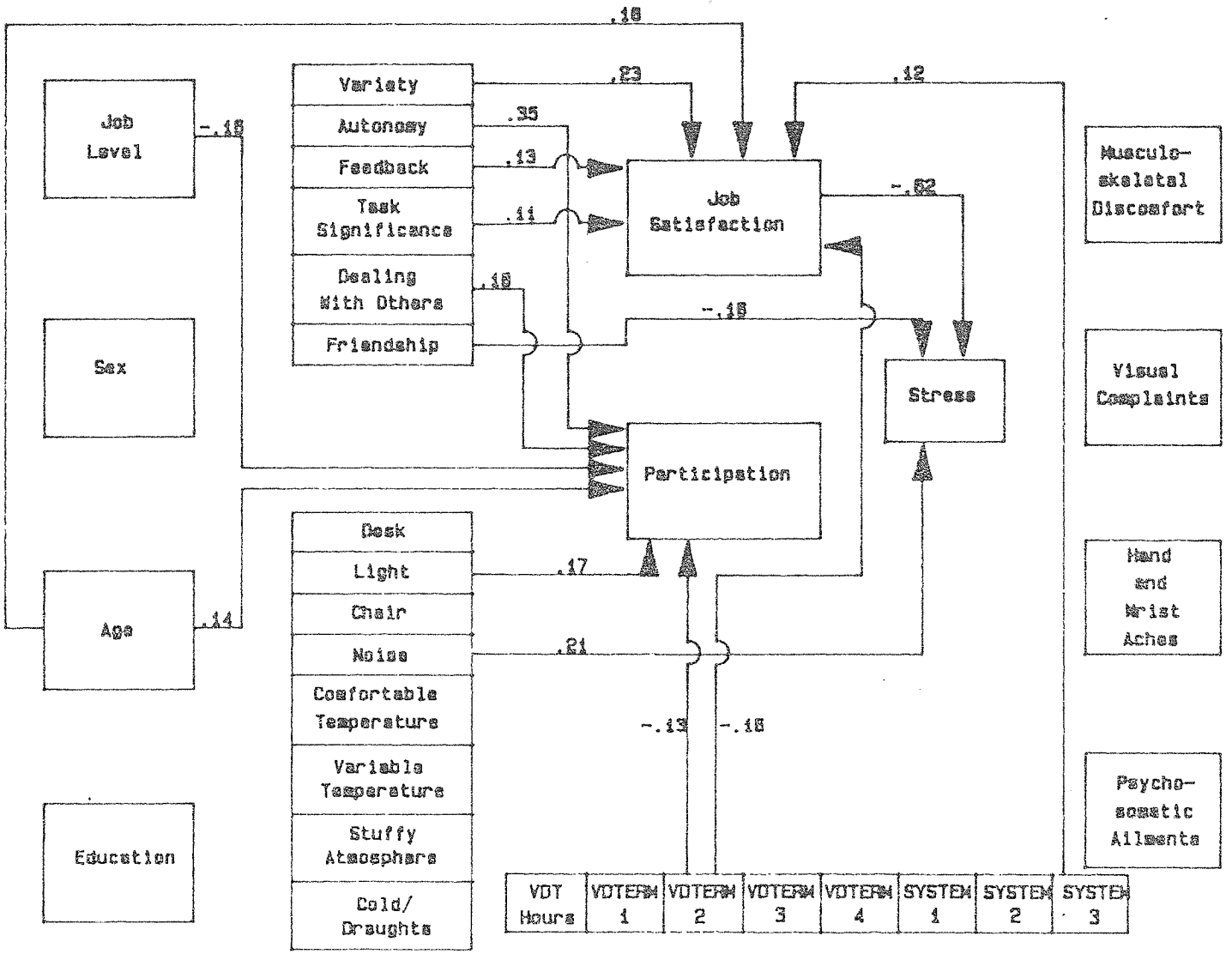


Diagram 14.6

Interactive Model for Office Worker's Responses:
the Post-implementation path coefficients for job level and sex to the office environment and job characteristic variables for the four sites

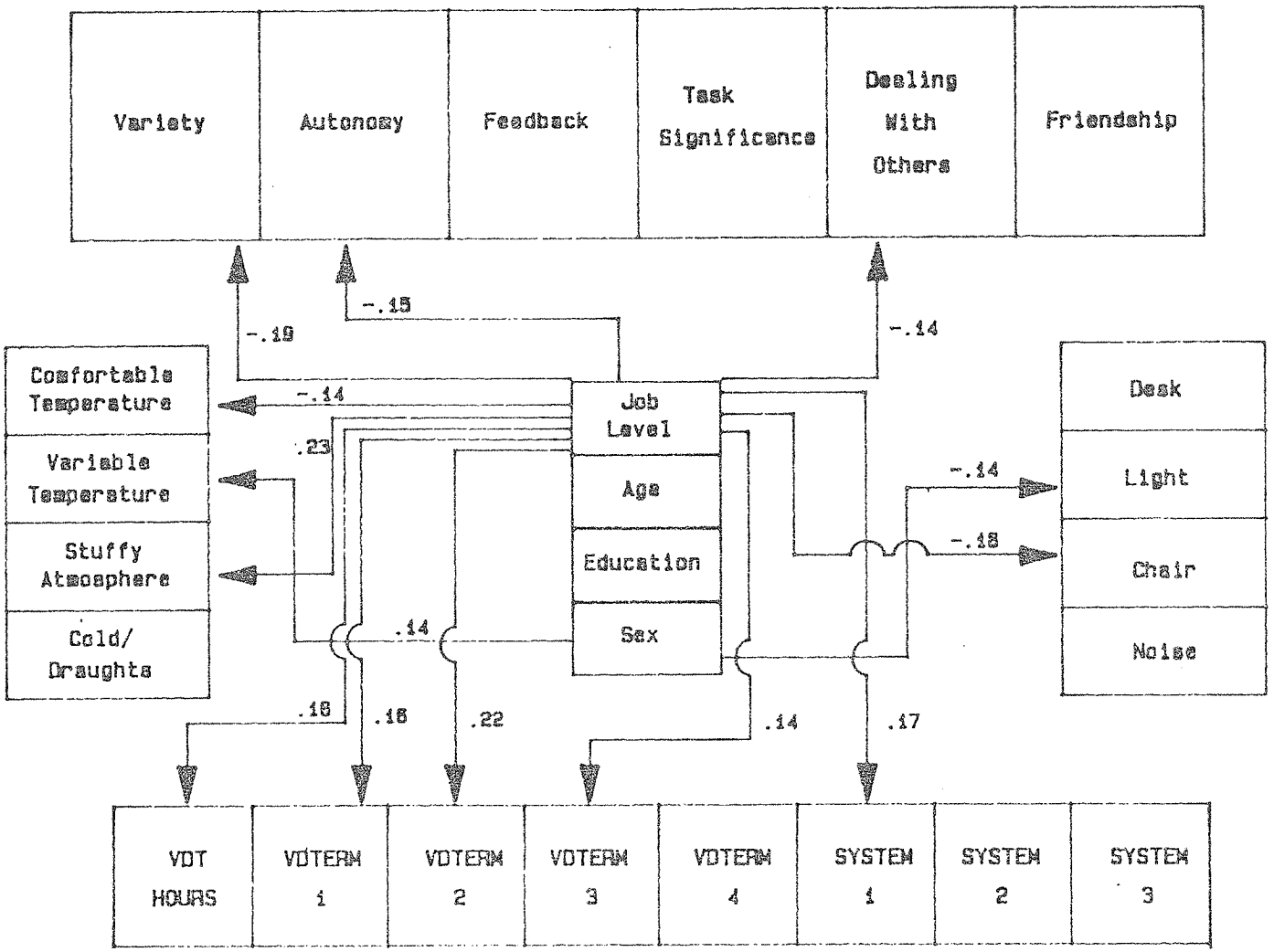


Diagram 14.7

Interactive Model for Office Worker's Responses:
the Post-implementation path coefficients for age to the office environment and job characteristic variables for the four sites

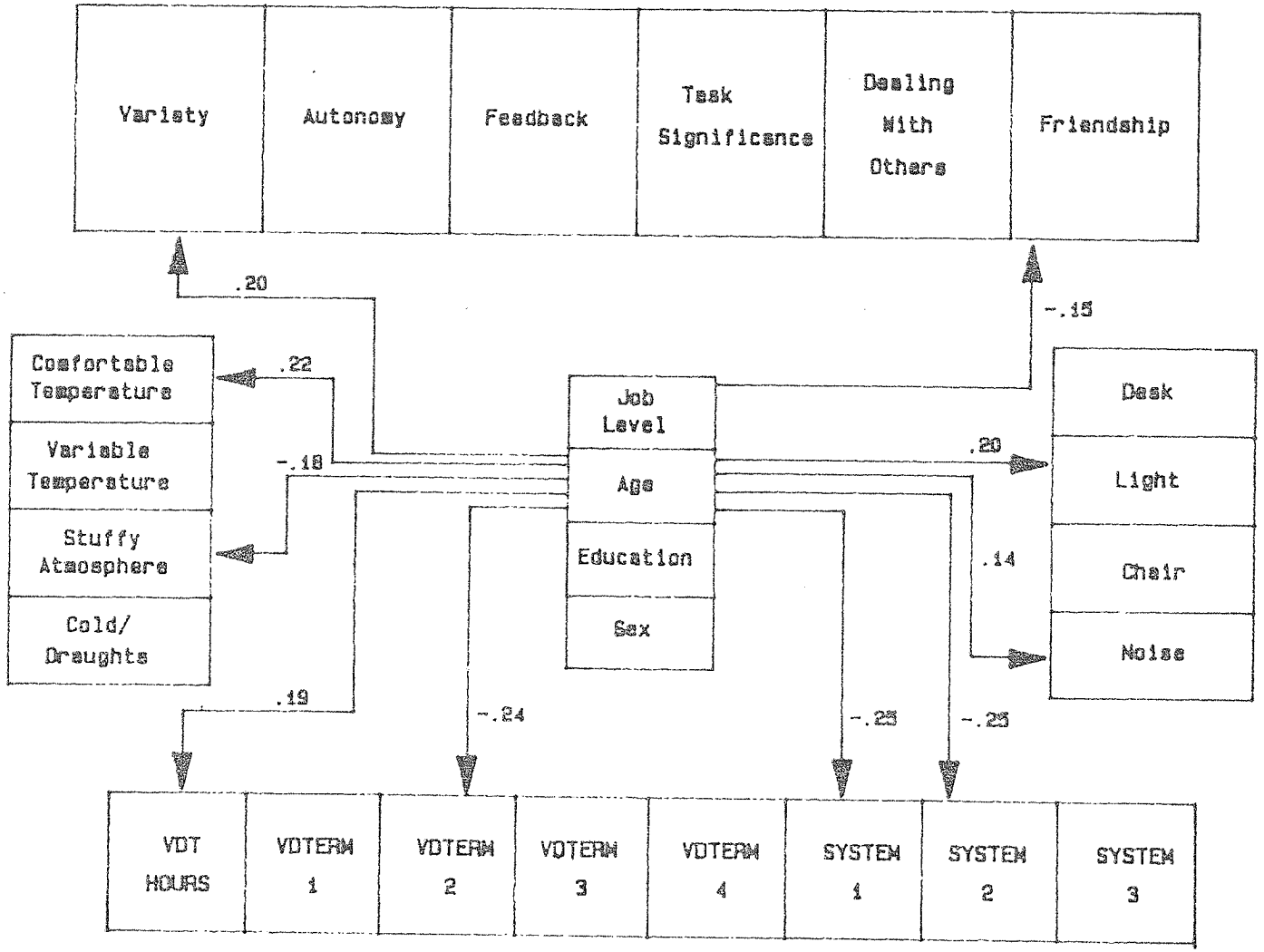


Diagram 14.8

Interactive Model for Office Worker's Responses:
the Post-implementation path coefficients for education to the office environment and job characteristic variables for the four sites

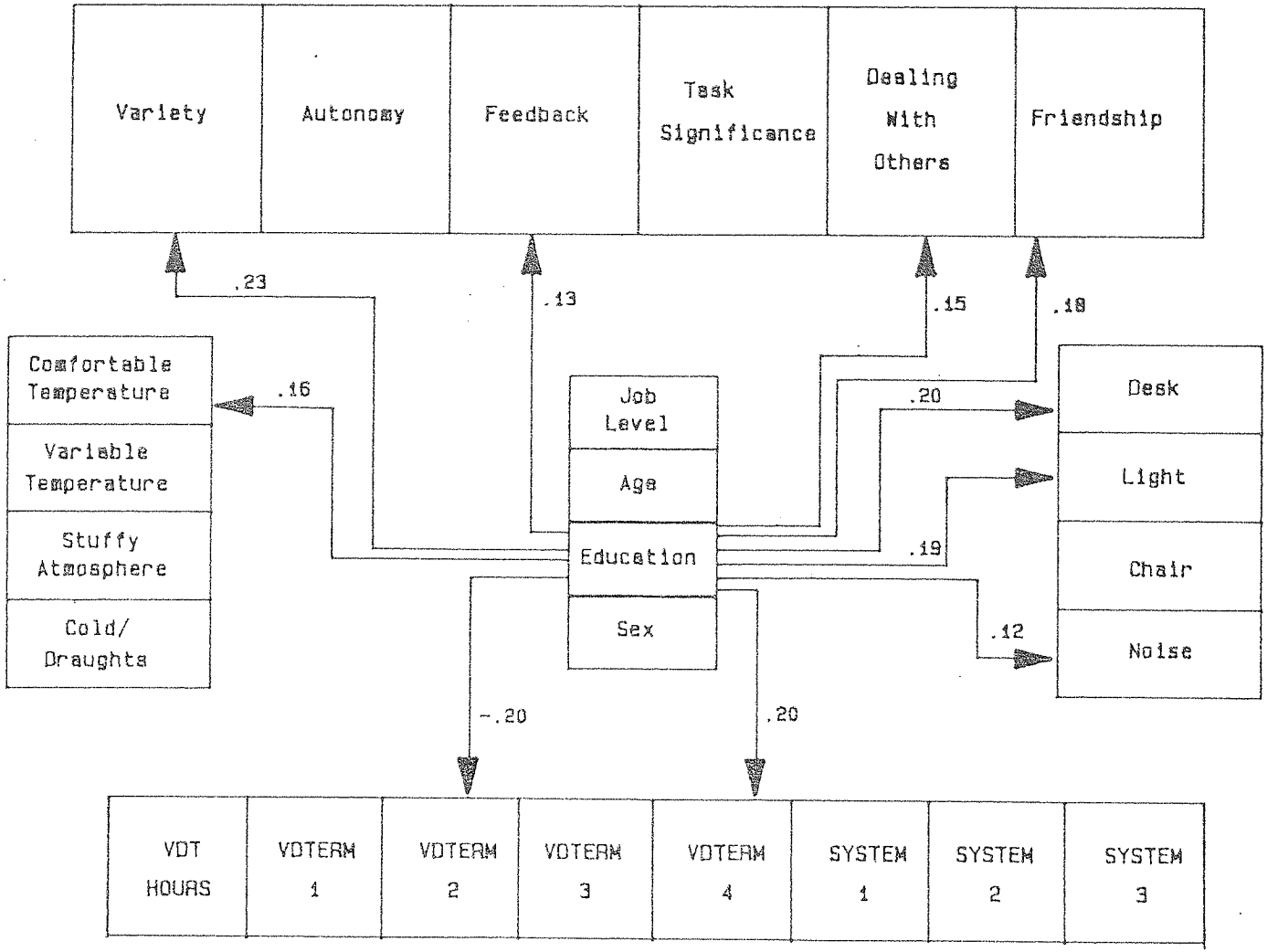


Diagram 14.10 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the female respondent's ILLNESS factors

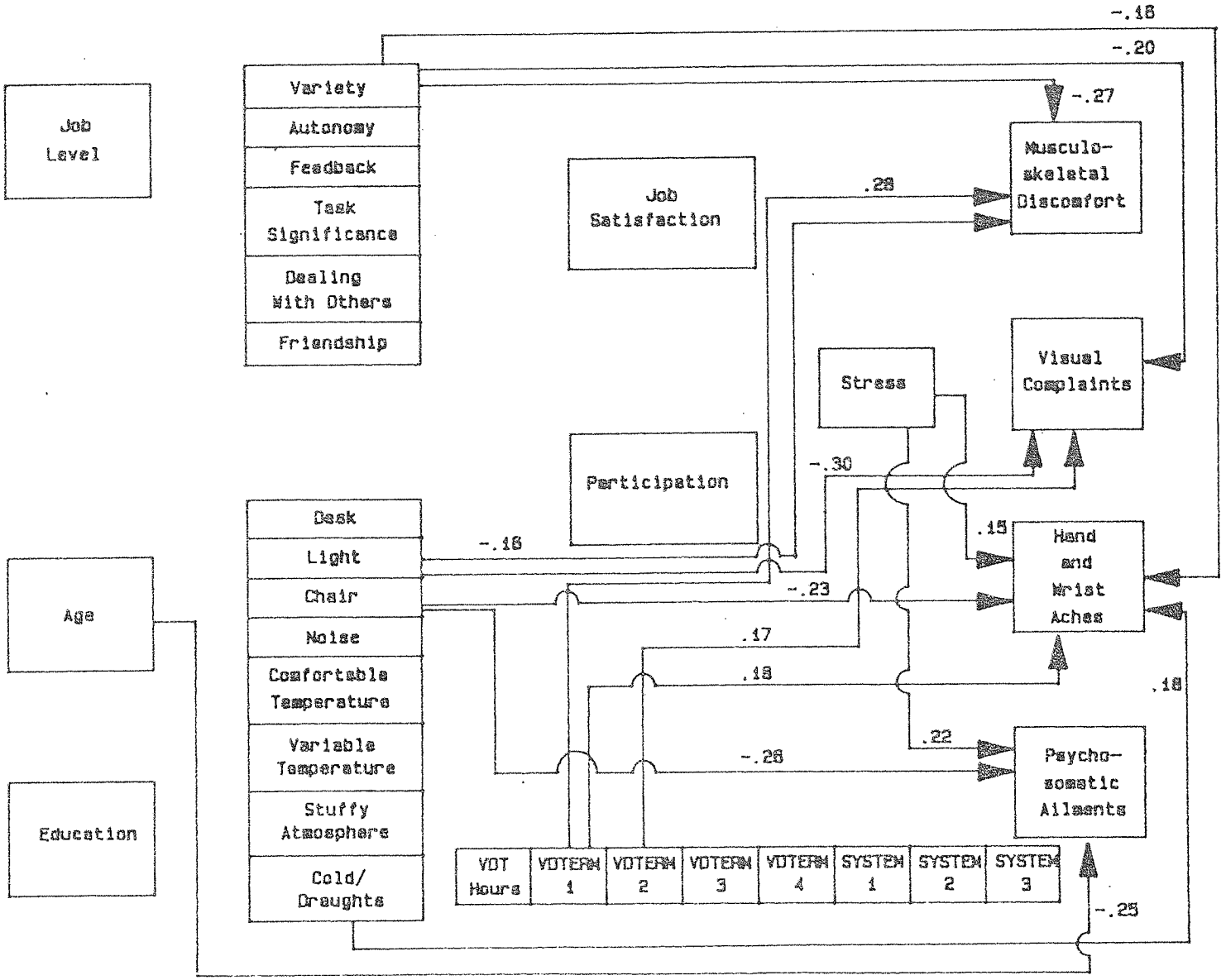


Diagram 14.11 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the female respondent's affective variables

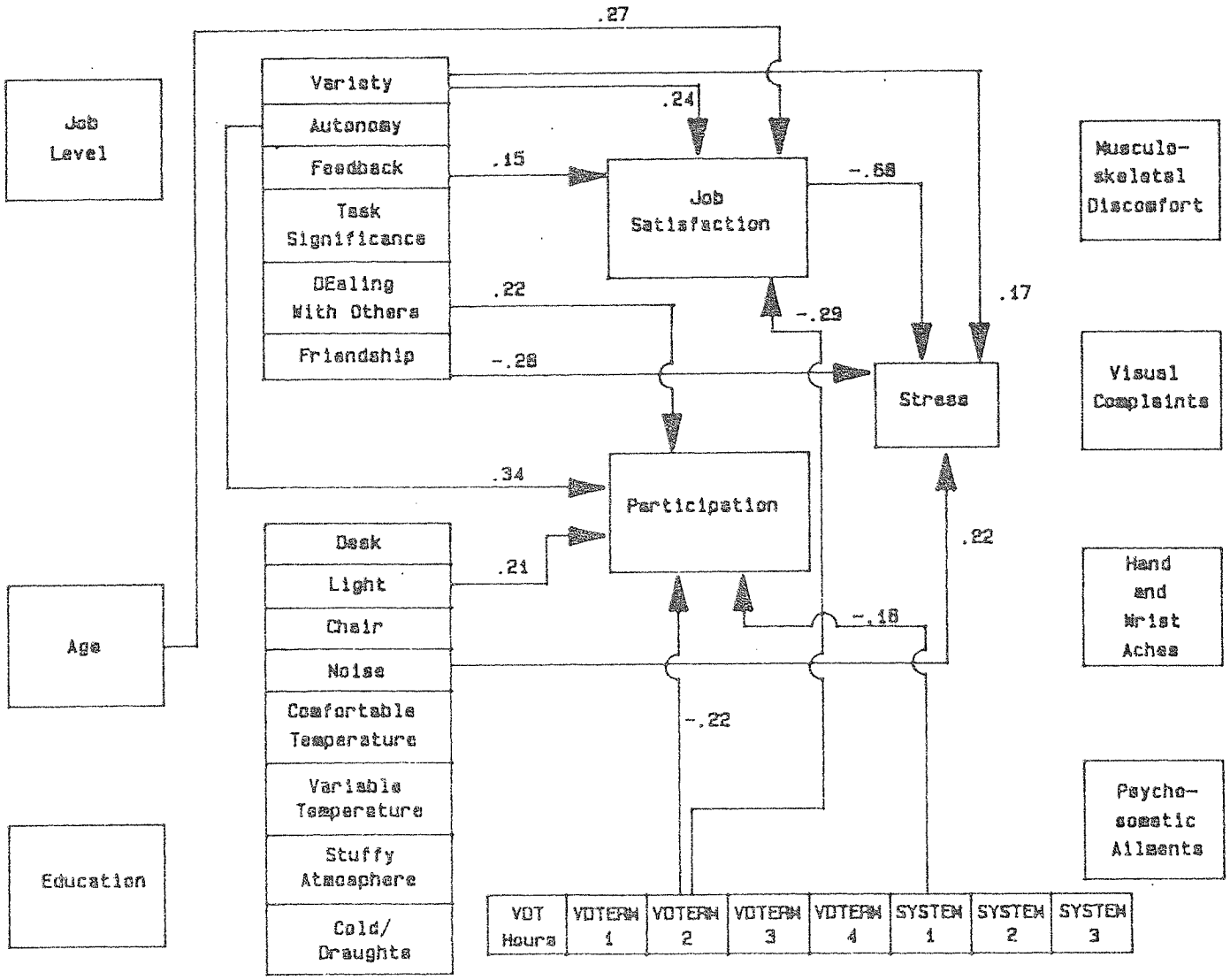


Diagram 14.12 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the male respondent's ILLNESS variables

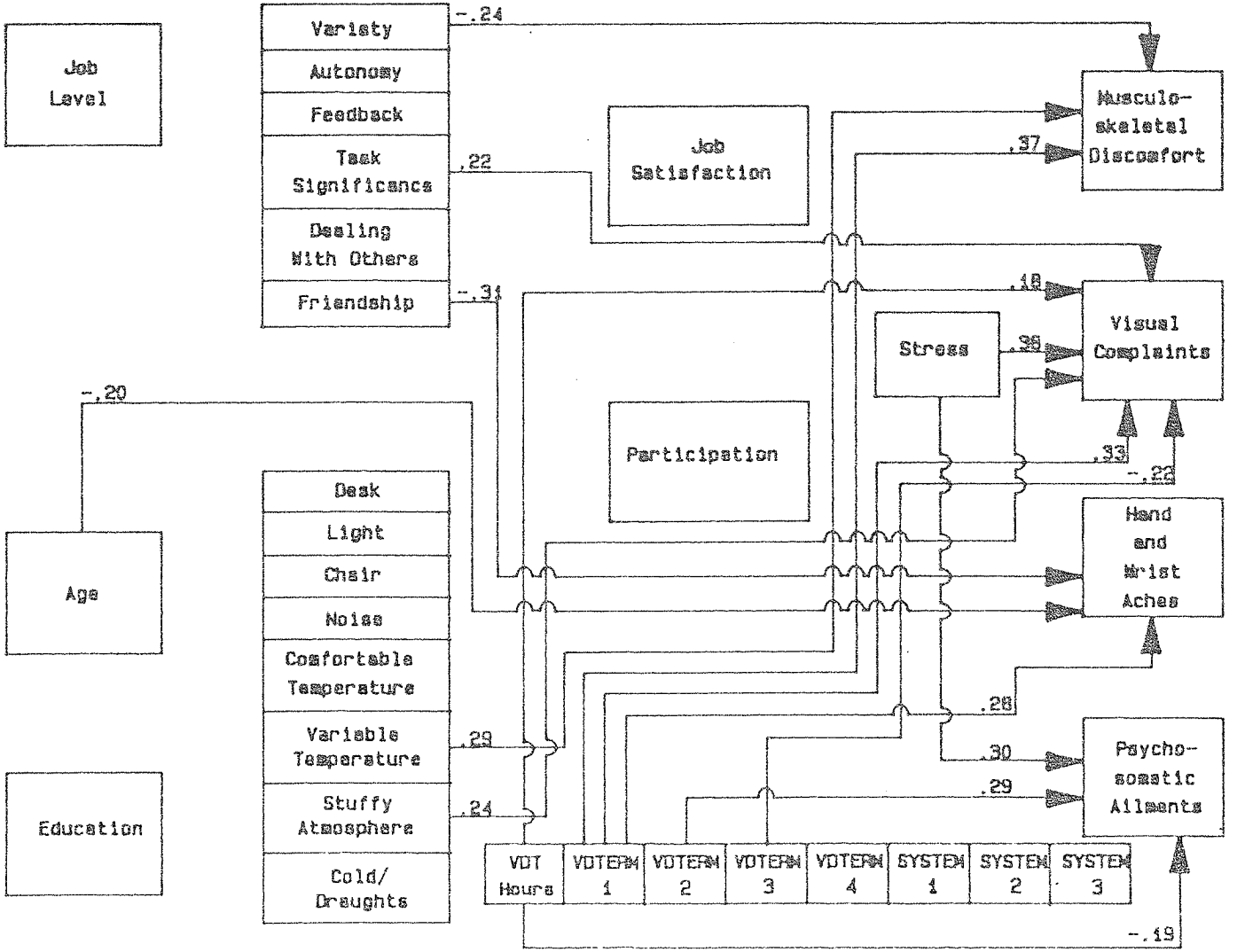


Diagram 14.13 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the male respondent's affective variables

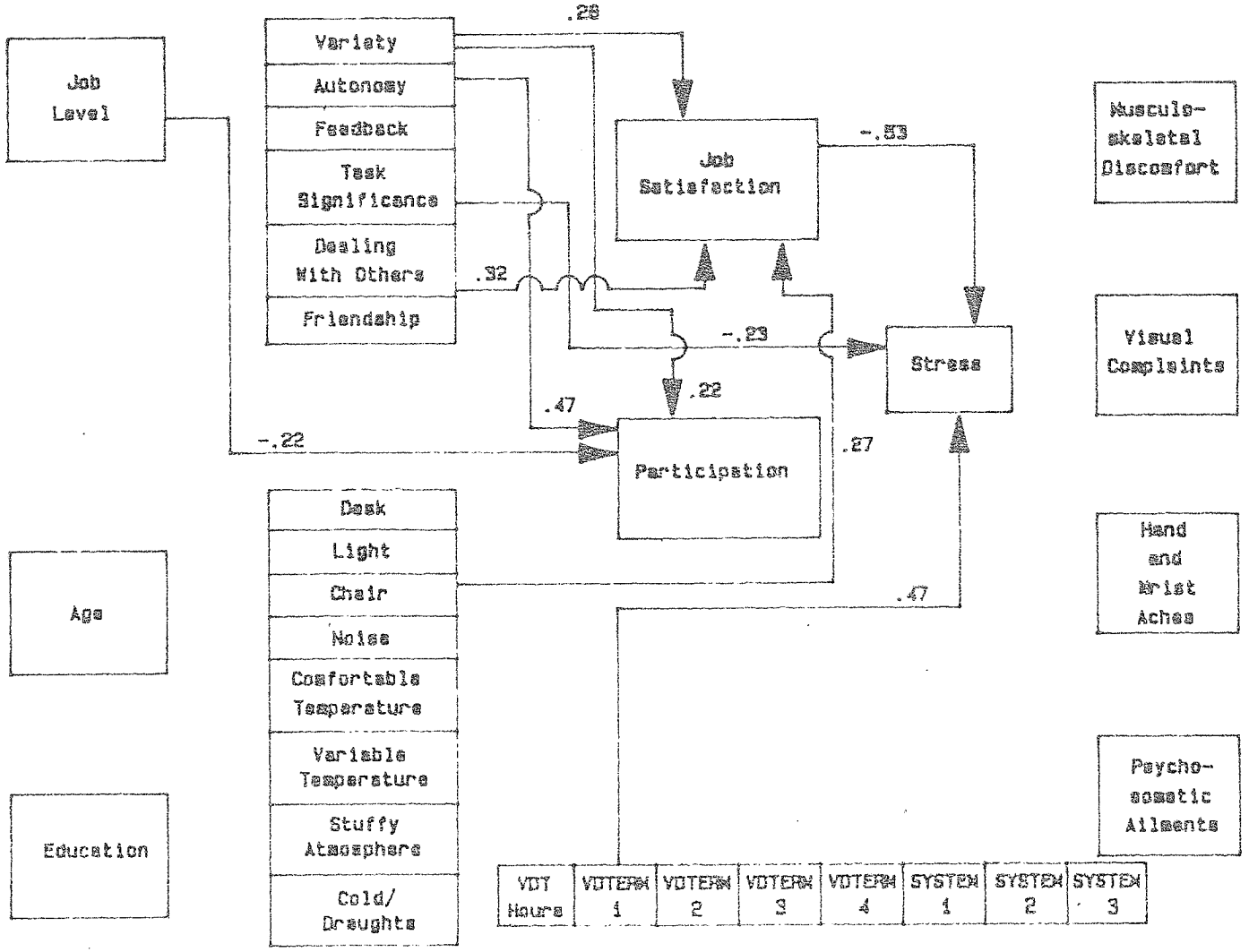


Diagram 14.14 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the managerial/professional respondent's ILLNESS factors

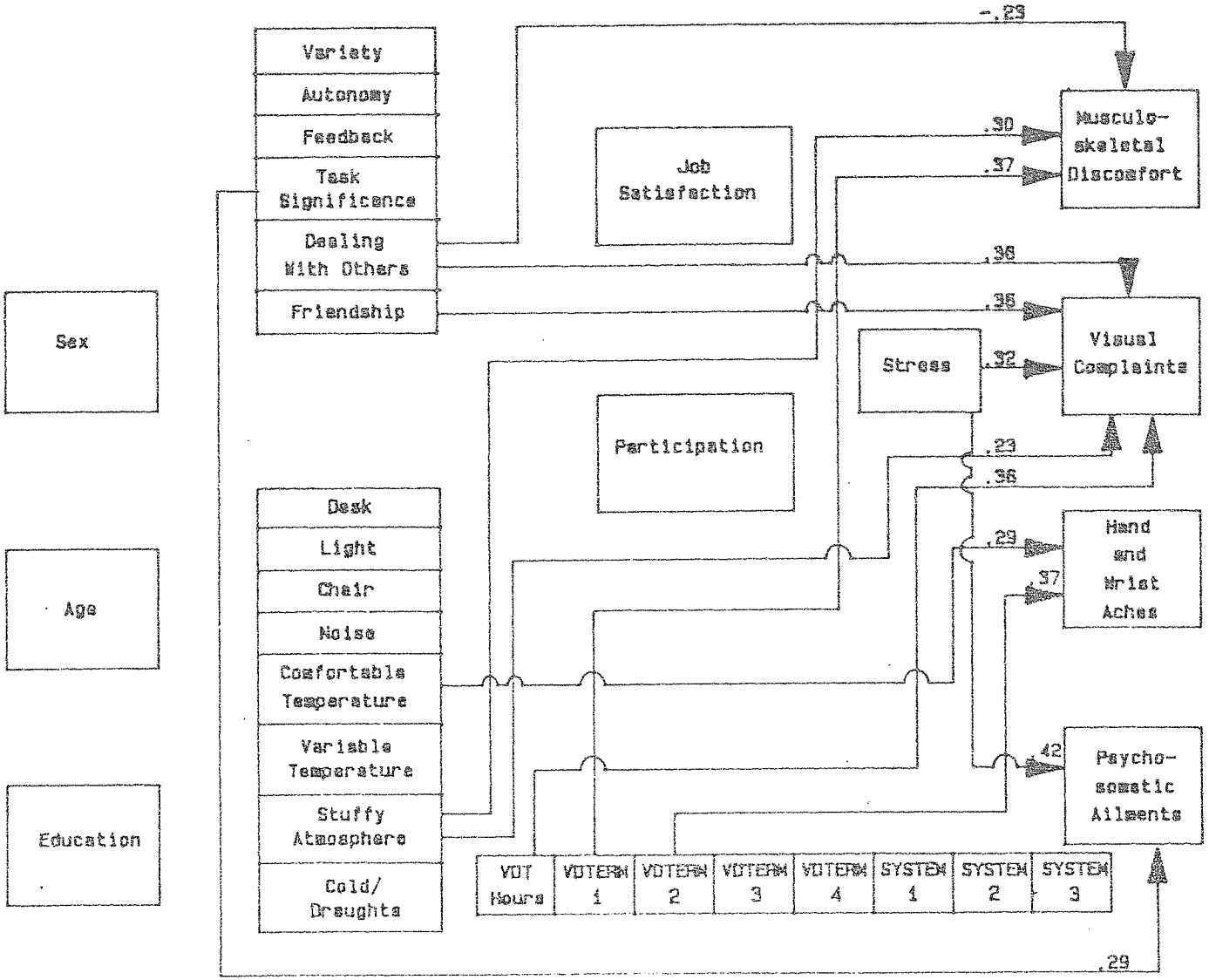


Diagram 14.15 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the managerial/professional respondent's effective variables

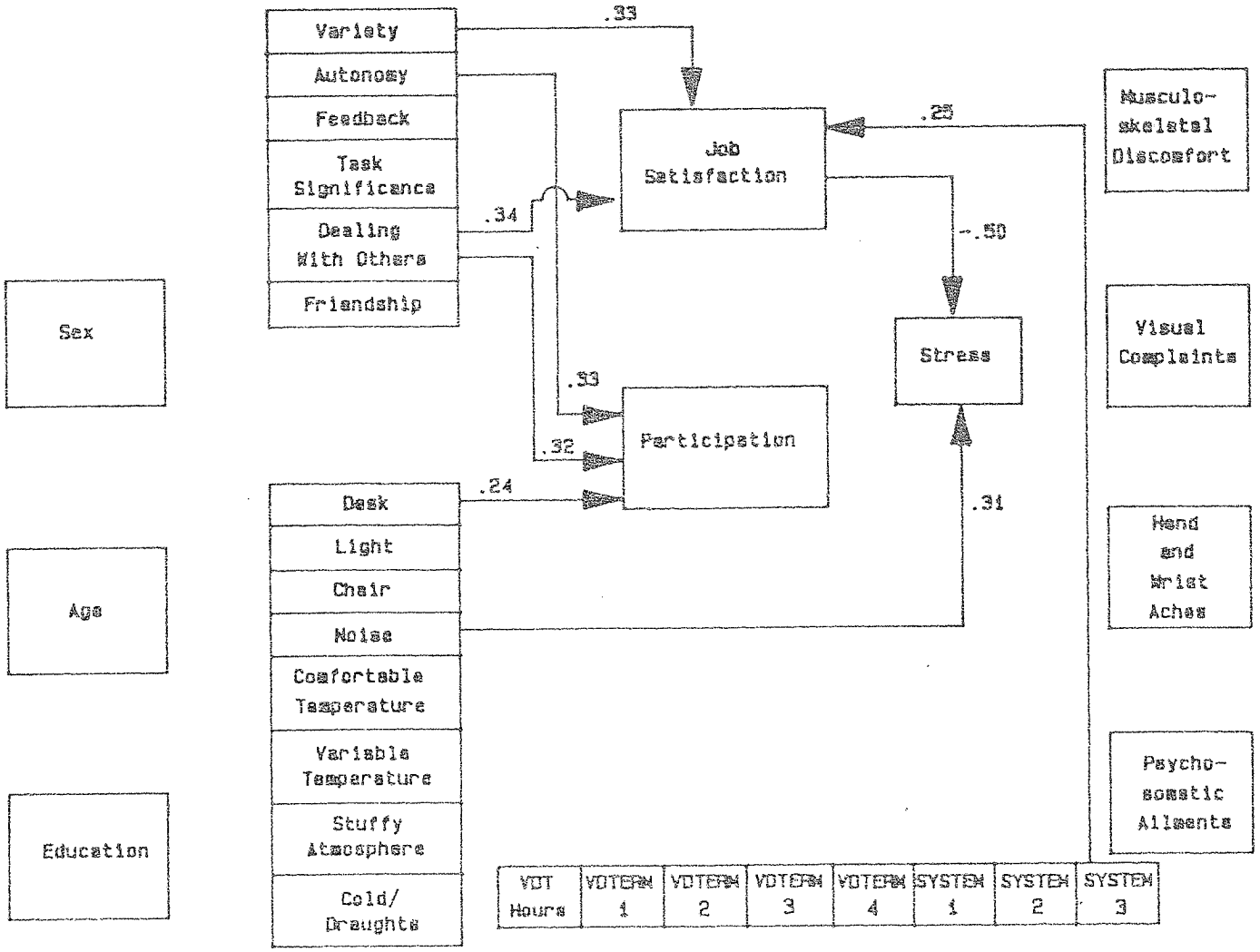


Diagram 14.18 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the clerical/secretarial respondent's ILLNESS factors

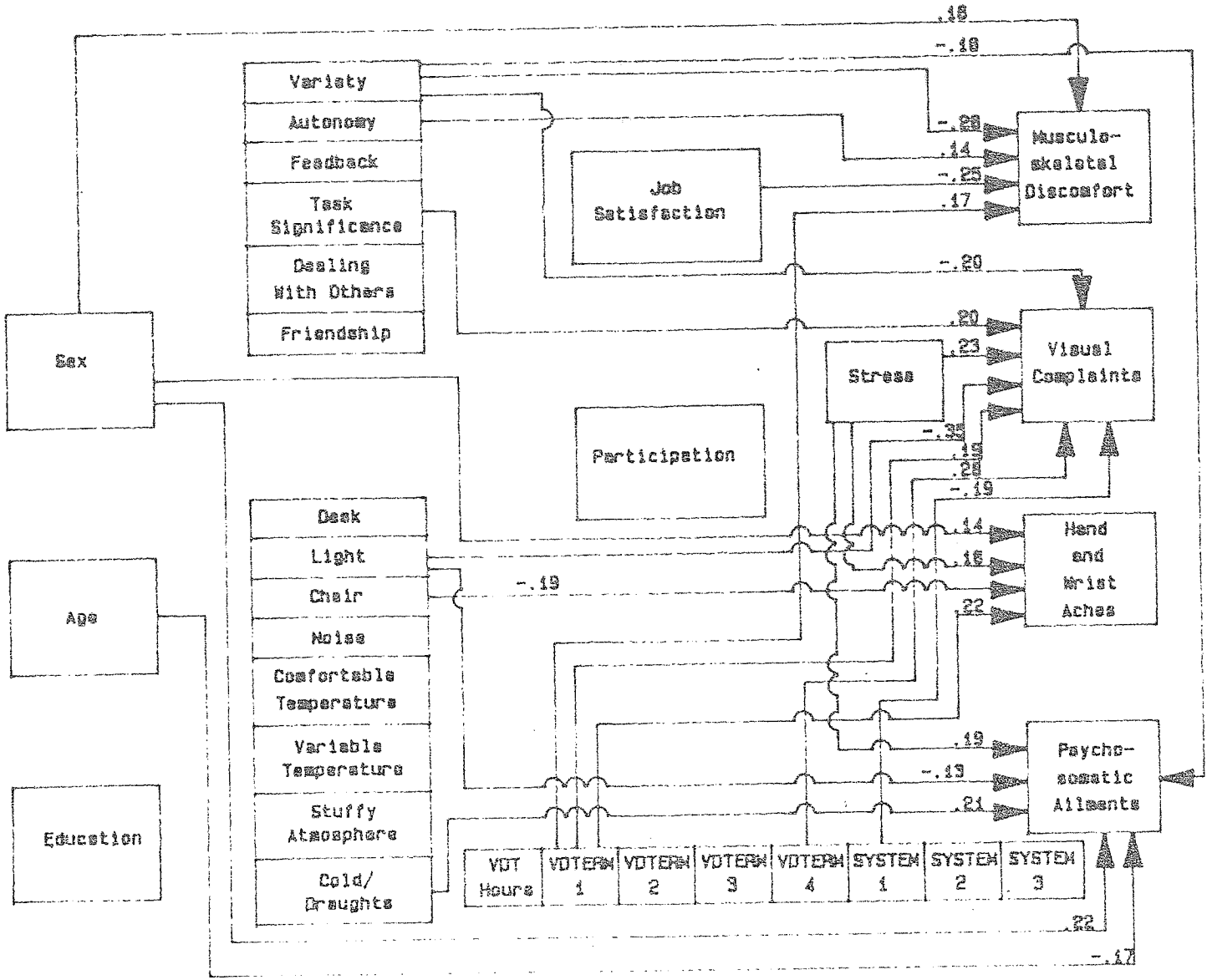


Diagram 14.17 Interactive Model for Office Worker's Responses: the Post-implementation path coefficients for the clerical/secretarial respondent's affective variables

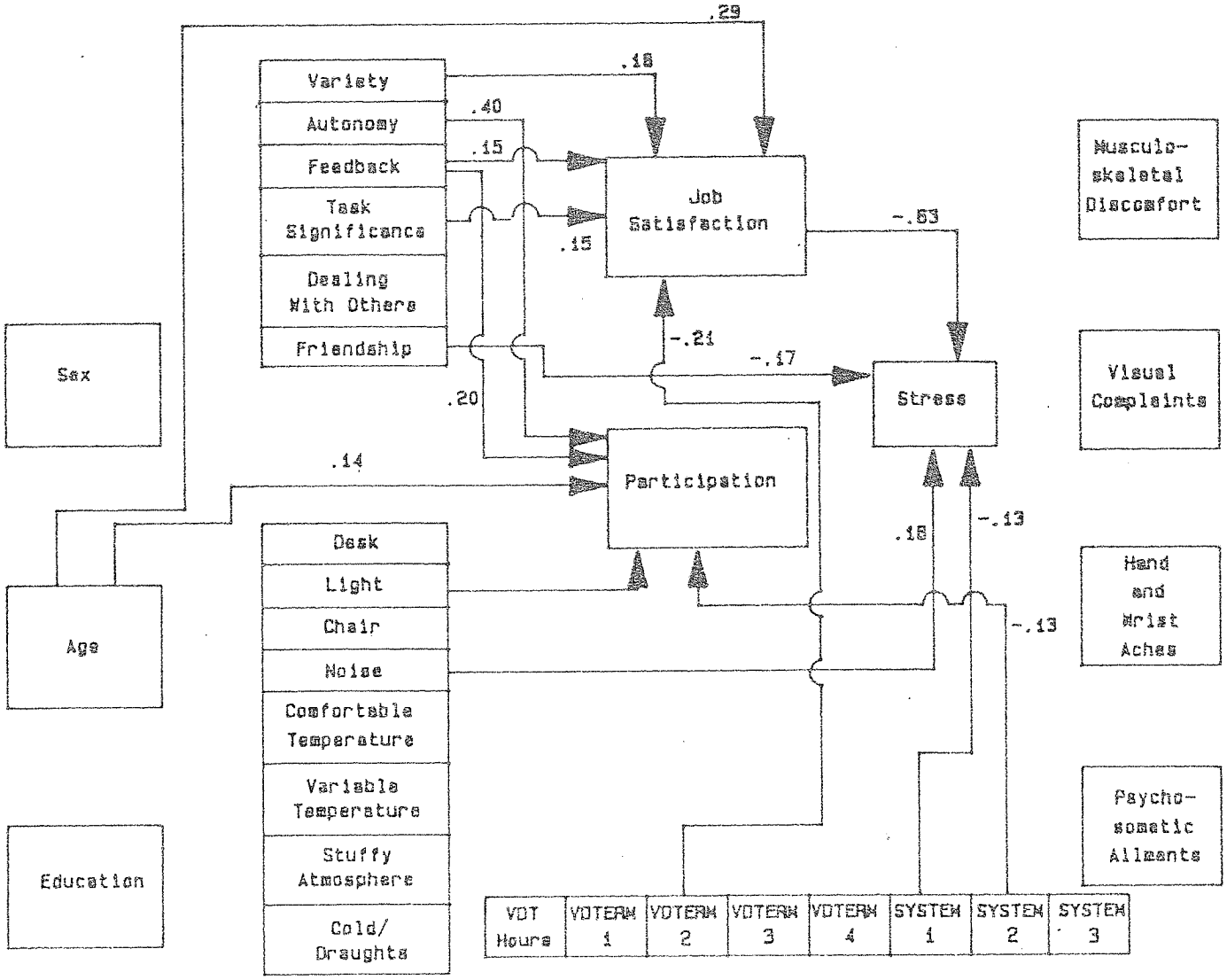


Diagram 14.18 Interactive Model for Office Worker's Responses:
the Pre-implementation Random Sample path coefficients for the ILLNESS factors.

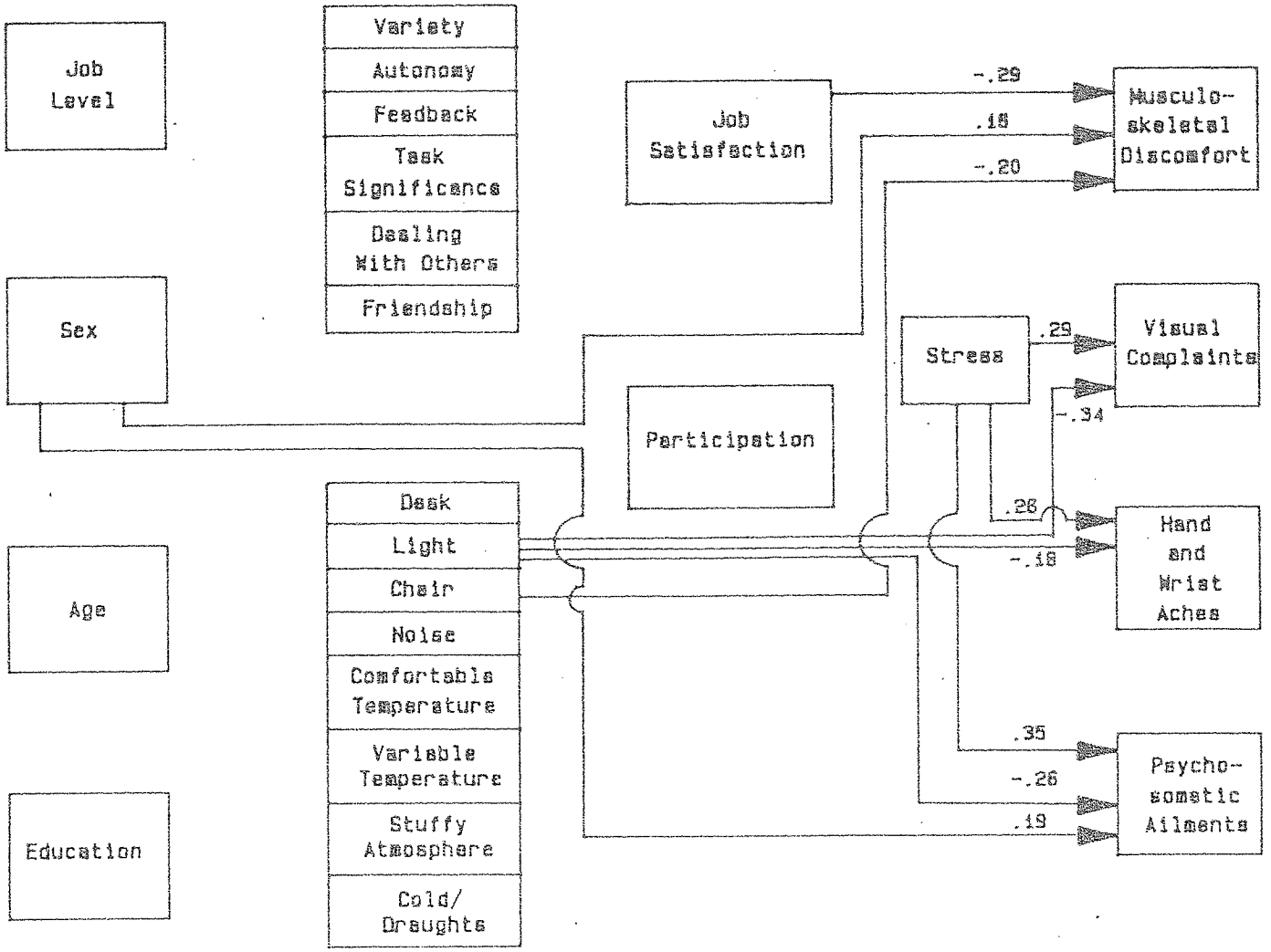


Diagram 14.19 Interactive Model for Office Worker's Responses:
the Pre-implementation Random Sample path coefficients for the affective variables

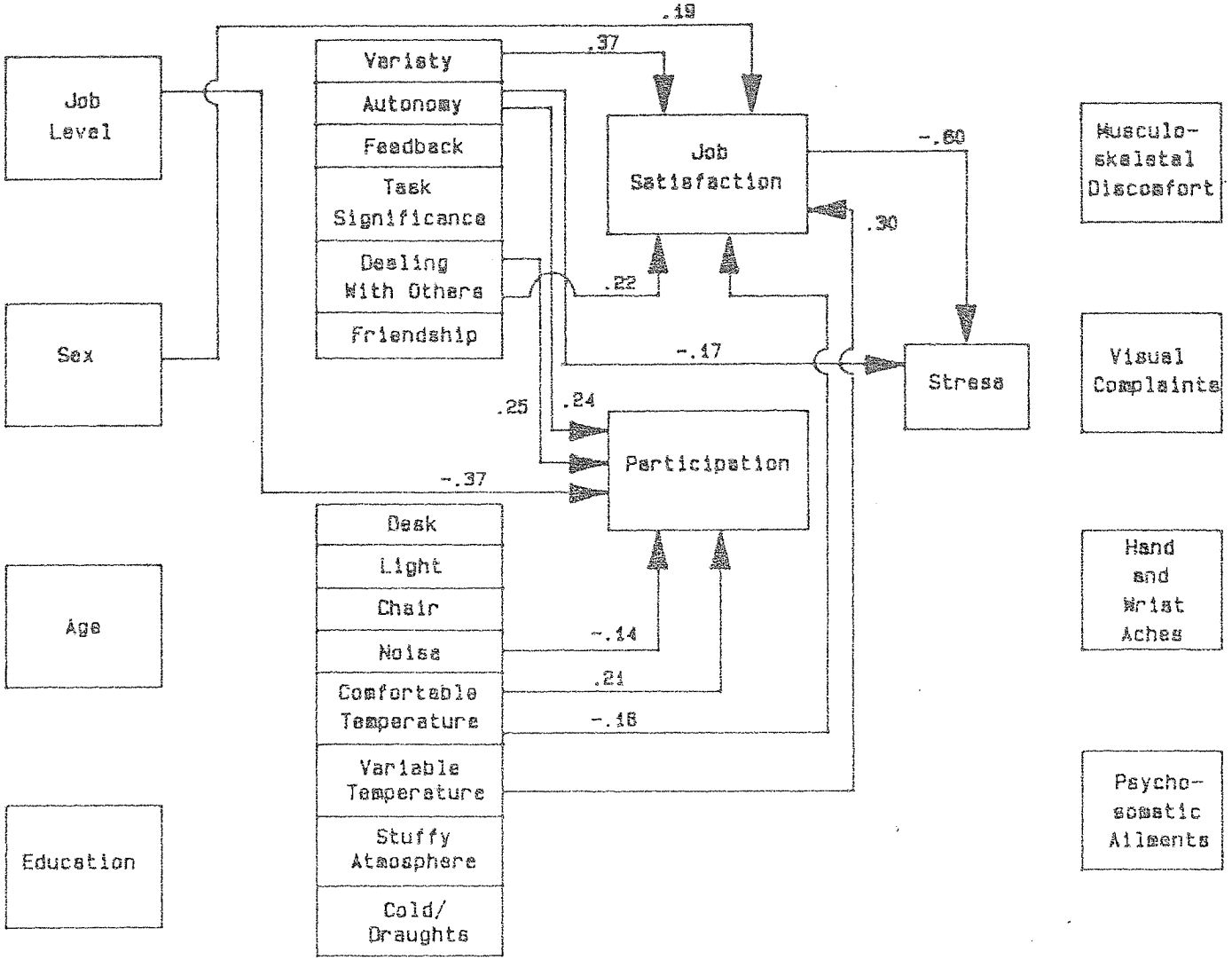


Diagram 14.20

Interactive Model for Office Worker's Responses:
the Pre-implementation Random Sample demographic variable's path coefficients
to the office environment and job characteristic variables.

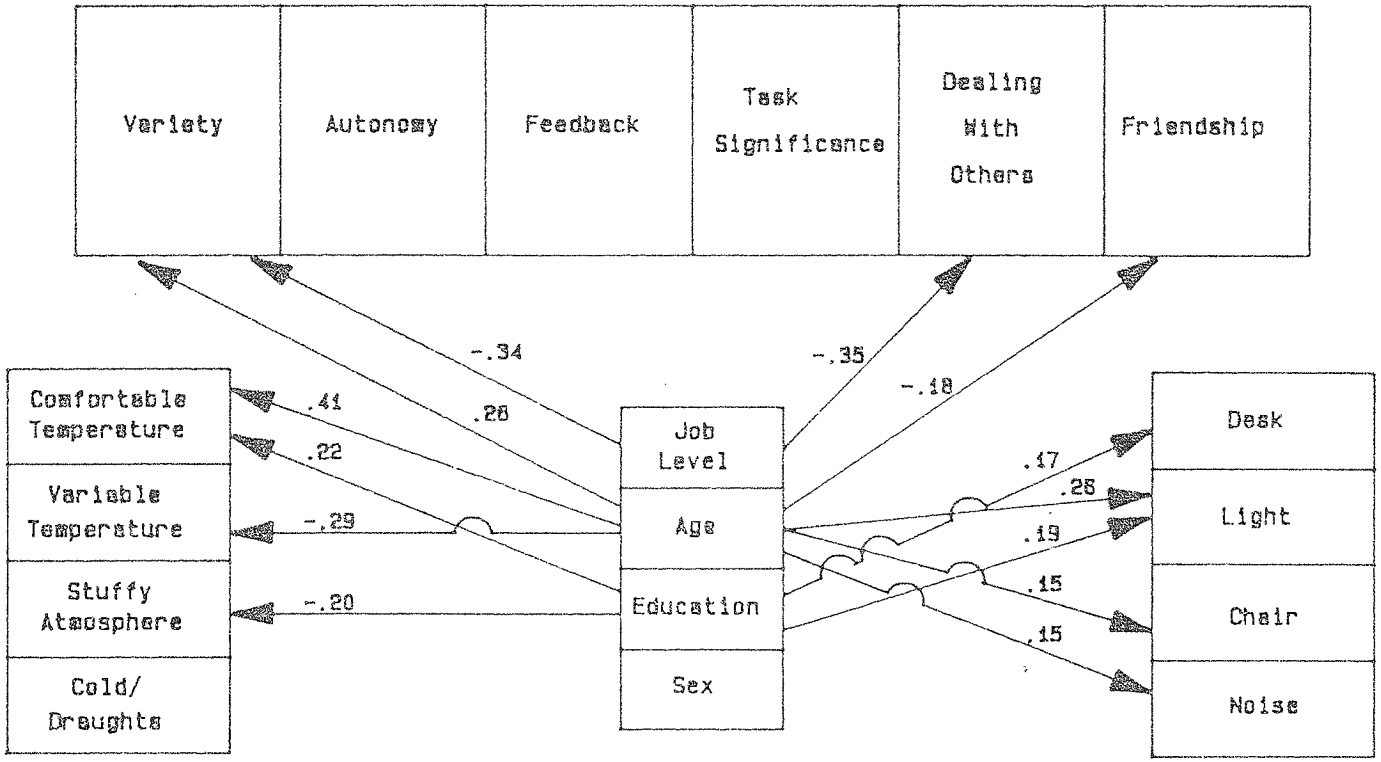


Diagram 14.21

Interactive Model for Office Worker's Responses:
the Post-implementation Random Sample path coefficients for the ILLNESS factors

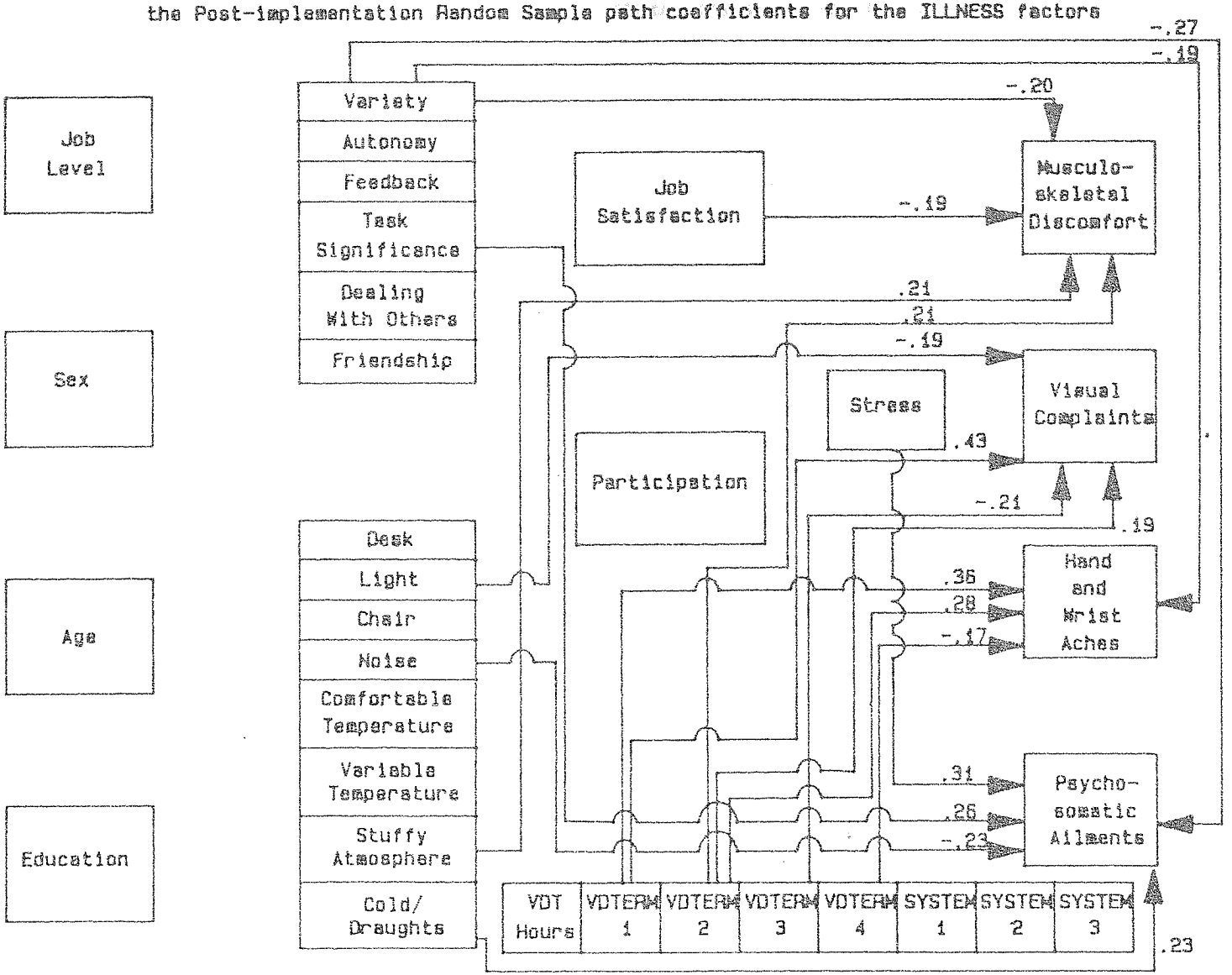


Diagram 14.22 Interactive Model for Office Worker's Responses:
the Post-Implementation Random Sample path coefficients for the affective variables.

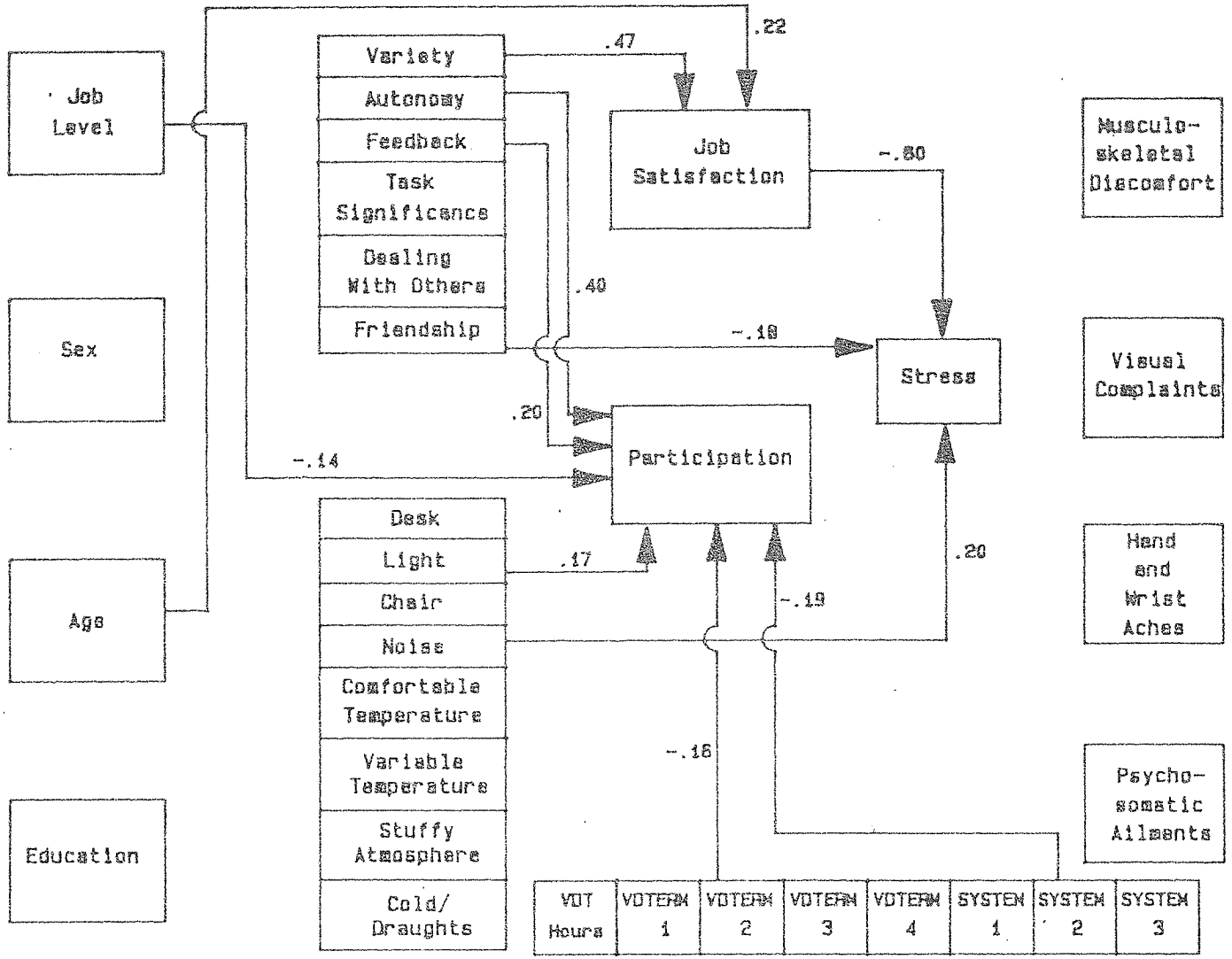


Diagram 14.23

Interactive Model for Office Worker's Responses:
the Post-Implementation random Sample demographic variable's path coefficients
to the office environment and job characteristic variables